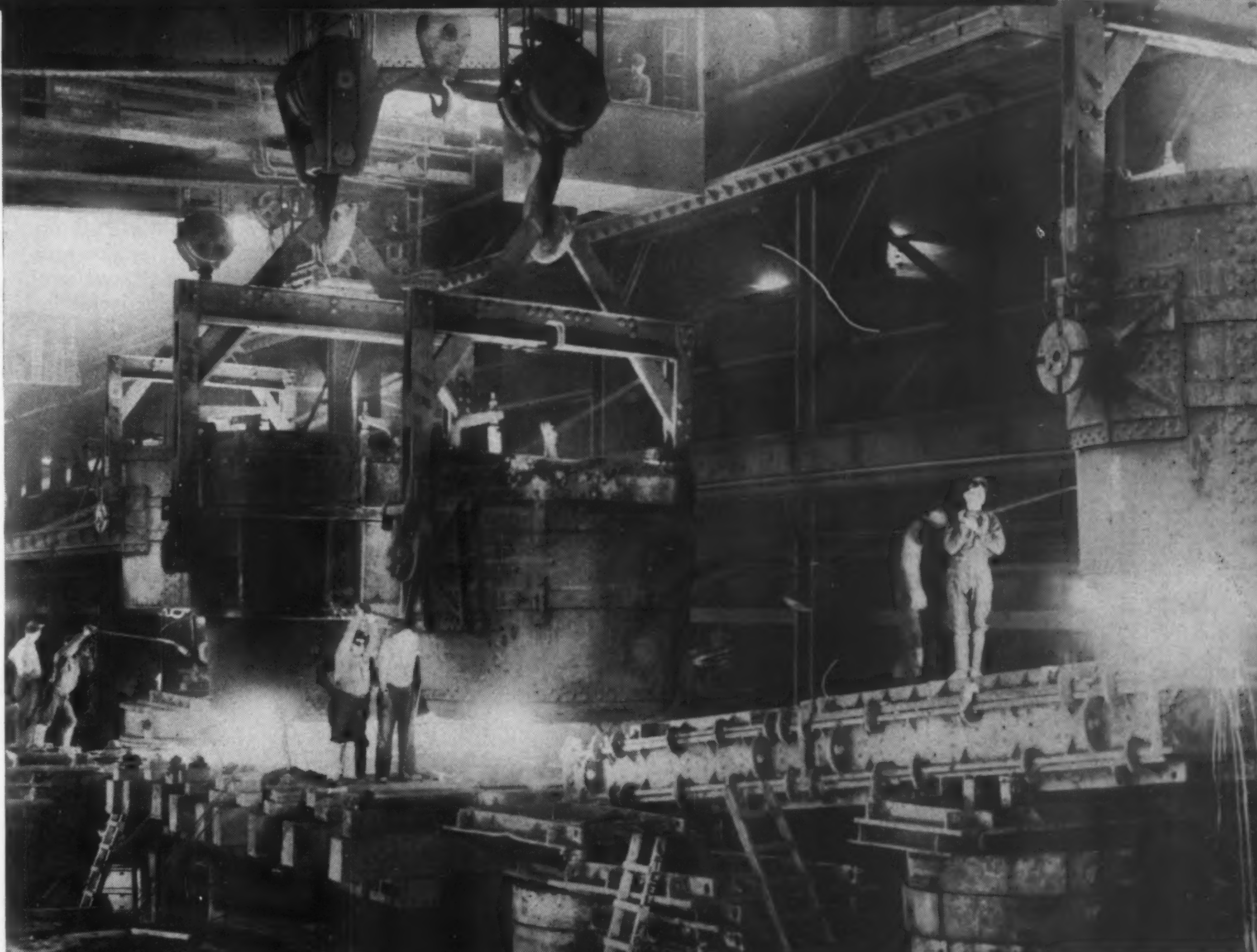
American Foundryman

A PUBLICATION PRESENTING ASSOCIATION AND CHAPTER ACTIVITIES



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July 1942

Our Duty to the Nation

TOTAL war as forced upon us by the Axis powers means only one thing to us as Americans: All of our acts, all of our manufacturing facilities, all of our skill and all of our energies must be devoted to the task of winning the war!

There are no compromises, no halfway measures which will accomplish our goal. Every hour saved in winning the war will mean savings in life and destruction, and reduction of future financial burdens.

In doing our part we, as American foundrymen, do not have an easy task. We must use our resourcefulness to overcome the handicaps of being unable to obtain all the materials necessary for production to which we are accustomed in peacetime. We must train a great number of men and women unfamiliar with foundry operations to provide the working force for increasing production and replacing men called for military service.

We must plan our production more carefully than ever before so that the war industries do not lack any of the vital castings necessary for war production. We must maintain quality in the face of many handicaps so that no implement of war shall fail because of the failure of a casting.

But American foundrymen in laboratories, offices and foundries must do even more—they must provide better metals, better methods, better maintenance of equipment and better over-all production.

The American Foundrymen's Association accepts its share in the responsibilities for aiding the war effort and no small part of this responsibility must be borne by the chapters. All of the activities of the Association will be judged by what they contribute in attaining this goal. Committees will concentrate on war problems and defer non-essential tasks for the duration. Programs will be planned that are of value now in helping a foundryman with his problems.

We foundrymen can and will accomplish the gigantic task before us.

D. P. Forbes

D. P. FORBES, President
American Foundrymen's Association

Duncan P. Forbes, president and general manager, Gunite Foundries Corp., Rockford, Ill., was elected President of A.F.A. at the 1942 Convention in Cleveland. Previously he had served the Association as its Vice-President (1941-42), as a Director (1938-40), and as a member of the Executive Committee of the Board of Directors. He also is chairman of the A.F.A. Malleable Division and the division's Advisory Committee. Mr. Forbes comes from a long line of foundrymen and pioneers in malleable iron, in which he has broad experience. Since 1928 he has headed the Gunite organization, founded to promote the manufacture and sale of high-test gray iron developed under his direction.

American Foundryman

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July, 1942

Volume 4 — **Number 7**

Published by the American Foundrymen's Association, Inc., 222 West Adams St., Chicago, Ill., for the purpose of presenting Association and Chapter activities. Published monthly. Subscription price, to members, $1.00 per year; to non-members, $1.50 per year. Single copies, 20c.

Entered as second class matter July 22, 1938, at the post office at Chicago, Illinois, under the Act of March 3, 1879.

Secondary Aluminum for Sand Castings

By W. E. Martin,* Brooklyn, N. Y.

Government specifications for aluminum castings for many years have been based on the use of virgin aluminum ingot. However, with the advent of the war and the scarcity of virgin aluminum, it has been necessary to utilize the so-called secondary aluminum in war work. The author and his company have made an extensive study to adapt secondary aluminum to their products and have been successful. The author presented this paper at a meeting of the Non-Ferrous Division of A.F.A., on April 21, during the recent Cleveland convention, with the hope that it would be of assistance to those companies which will find it necessary to use secondary aluminum alloys in their foundries instead of the virgin aluminum alloys to which they are accustomed. Because of the great interest in this paper, it is reproduced here to make the data contained in it available as soon as possible to those foundries producing war work.

As the result of recent W.P.B. restrictions on the use of primary aluminum, a large part of the castings used in the defense effort must hereafter be made of secondary aluminum. The work discussed in this paper was initiated in the Sperry Gyroscope Company Materials Laboratory in January, 1942, at which time it was apparent that such restrictions would eventually come about. In the meantime, a substantial number of the castings used in Sperry non-flying equipment have been and are being produced of secondary aluminum. Work is now under way to convert castings used in Sperry aircraft equipment to secondary metal as quickly and completely as possible—the notable exceptions being castings used in aircraft structures. We have had some trouble in the changeover, and had it not been made gradually and with considerable experimental work, serious production delays would have resulted. This paper is presented with the hope that, by pointing out the dangers involved as determined by our work, some production delays and equipment failures may be prevented somewhere in the defense industry.

Requirements of a Secondary Alloy

Most aluminum alloys as produced by primary aluminum producers are made from virgin metal and contain extremely small percentages of impurities. For some purposes, it is important that these impurities be maintained at the low limits which have been set by most government specifications. However, it is impossible, when reclaiming turnings, borings, scrap, stampings, and spoiled work, to keep the impurities at the limits set by these virgin metal specifications. The term "secondary aluminum" has been applied to this reclaimed material.

It has become extremely important to utilize all aluminum available in the country for defense work. The secondary material will be a mixture of silicon-bearing aluminum, copper-bearing aluminum, and other miscellaneous grades. Because of the impossibility of keeping all scrap segregated on the basis of its original analysis, any secondary composition readily available must be a blend of the metal available to the smelters.

To be useful to the foundries, the secondary material must cast well, should be reasonably easy to straighten, and, for our purposes, must machine at least as well as the primary materials which we have been using, and must have satisfactory mechanical properties. It has been agreed by all the procurement boards that a lower corrosion resistance will be acceptable. From previous experience in the casting of intricate instrument parts, it had been determined that a minimum silicon content of 3¼ per cent should be maintained. After numerous conversations with the secondary smelters, it was determined that an alloy having approximately 3 per cent copper and 4 per cent silicon should be available in sufficient quantities to cover the production of our equipment. It was further determined that an alloy of 3 per cent silicon and 4 per cent copper would be the most available secondary alloy.

Table 1

Composition of Heats Studied in the Investigation

Heat	*Cu*	*Si*	*Mg*	*Fe*	*Ni*	*Mn*	*Zn*
Alloy 40	2.75	3.50	0.48	0.95	0.26	0.13	0.48
40K	2.38	3.55	0.08	1.28	0.50	0.22	0.10
40L	2.25	2.30	0.02	0.70	0.09	0.38	0.04
40D	2.38	3.55	0.41	1.28	0.50	0.22	0.10
40M	3.00	4.25	0.04	0.93	0.12	0.50	0.05
40B	2.64	3.37	0.16	1.19	0.54	0.20	0.43
40P	3.11	4.18	0.10	0.80	0.10	0.20	0.42
40Q	4.10	2.15	0.01	0.81	0.07	0.36	0.14

Table 2

Chemical and Physical Limits of Secondary Alloy No. 18 Sand Castings

Chemical Requirements

Element	*Per Cent*
Copper	2.25 to 3.5
Silicon	3.25 to 4.5
Magnesium	0.10 Max.
Iron	0.9 Max.
Nickel	0.4 Max.
Manganese	0.6 Max.
Zinc	0.6 Max.
Others Total	0.5 Max.
Aluminum	Remainder

†Physical Requirements

*Yield Strength, p.s.i.	15,000 Min.
Tensile Strength, p.s.i.	23,000 Min.
Elongation, per cent in 2-in.	1.5 Min.

†As heat treated for 5 hours at 450°F.
*Stress required to produce 0.2 per cent offset from the modulus line.

*Materials Laboratory, Sperry Gyroscope Co.

Table 3

Casting Alloys Used

Alloy	Alcoa Number	Yield Strength p.s.i.	Tensile Strength p.s.i	Elongation Per Cent in 2-in.
		Minimum Values		
2*		17,000	25,000	1.0
11	45	not req'd.	19,000	1.5
12	43	not req'd.	17,000	3.0
14	356T6	20,000	30,000	3.0
		Typical Values		
2 (as cast)		20,000	33,000	2.5
2 (as stress rel. at 450°F. for 5 hours)		18,000	33,000	2.5
11	45	10,000	21,000	5.0
12	43	8,000	20,000	7.0
14	356T6	23,000	33,000	4.5

*A Sperry alloy 17 per cent zinc, 3 per cent copper, remainder aluminum.

Table 4

Heat Treatments Used

Treatment	Temp. °F.	Time, hrs.	
Annealing	750	1	Air Cooled
Stress Relieving	450	5	Air Cooled
Solution H.T. and Artificial Aging..	950	15	Water Quench
followed by	320	3	Air Cooled

Tests

On the basis of preliminary information, some large and intricate parts were cast of metal having the composition listed in Table 1 as alloy No. 40. Considerable cracking, lack of weldability and poor straightening properties were developed by this material. This material was not considered usable. Therefore, a series of tests was undertaken to try to determine the effects of impurities.

It will be noted that the material used in the above test contained approximately 0.5 per cent magnesium. Scrap, as received by the secondary smelters, normally contains magnesium varying from 0.2 to 1.0. It was suspected that magnesium was the element causing the embrittlement in these first castings made. To find the effect of magnesium, a series of tests was run covering magnesium contents of from 0.02 per cent to 0.41 per cent. Tests were also run varying the copper and silicon contents, and a reasonably complete coverage of other impurities was made. Castings, transverse test bars and standard 0.505-in. diameter test bars were made in sufficient quantities to establish the mechanical properties and the effects of various heat treatments. Fairly early in the test, anodizing and machining tests were conducted. Preliminary tests were made on the dimensional stability of the alloys in question.

Test Results

On the basis of the work performed, during which over 250 mechanical tests were run and approximately 60,000 lb. of metal converted into usable castings, a specification was drawn up to cover a secondary alloy to be referred to hereafter in this paper as alloy No. 18. The chemical and mechanical limits are given in Table 2. Consideration was given during these tests to the most rapid production methods possible, utilizing a minimum amount of heat treatment.

To evaluate the test results given, it is necessary to review

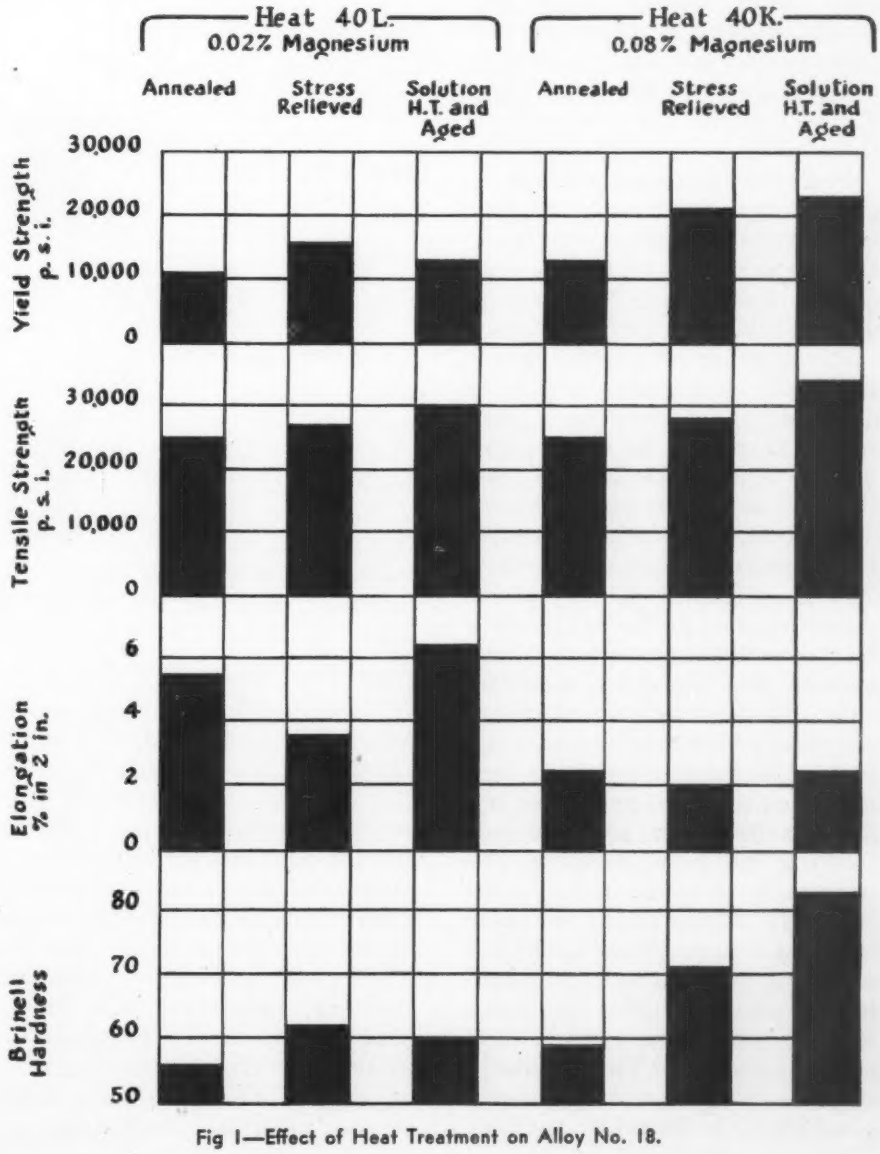


Fig 1—Effect of Heat Treatment on Alloy No. 18.

the properties of present alloys used by the company. These are listed in Table 3. It should be realized that for equipment manufactured by the Sperry Company, it is important not to permanently deform a casting during service. This deformation is limited only by the yield strength of the material, whereas ultimate breakage is a factor of the tensile strength. It will be noted from Table 3 that alloys Nos. 11 and 12 have low yield strengths.

Analysis of Heats

To cover the range of properties to be expected, two series of heats have been selected for complete detailed presentation. Heat 40L represents the low end of the composition range expected, covering both major elements and impurities. Heat 40M represents low impurities with average copper and silicon. Heat 40K covers average copper and silicon with high impurities, and 40D represents a heat containing excessively high magnesium. Table 1 gives the analyses of these heats.

Secondary aluminum alloys, in general, as-cast have quite low elongations. Typical values in this respect as-cast and one week old are 2 per cent. This may be detrimental in straightening of castings prior to machining, resulting in some cracks, or at least straining the casting to a point where it might be endangered during its service life. A further objection to a strained casting is the tendency to distort during machining operations.

A large number of the alloys now in use, particularly alloy No. 14 and the secondary alloy, contain age hardening constituents. These result in changing physical properties and may affect dimensions over a long period of time following casting. Stress relieving, or solution heat treating and artificial aging, satisfactorily prevent this condition. It is necessary to take reasonable precautions in the use of a new material and the possibilities of using heat treatment in this respect have been carefully considered. The results of this investigation are shown graphically in Fig. 1.

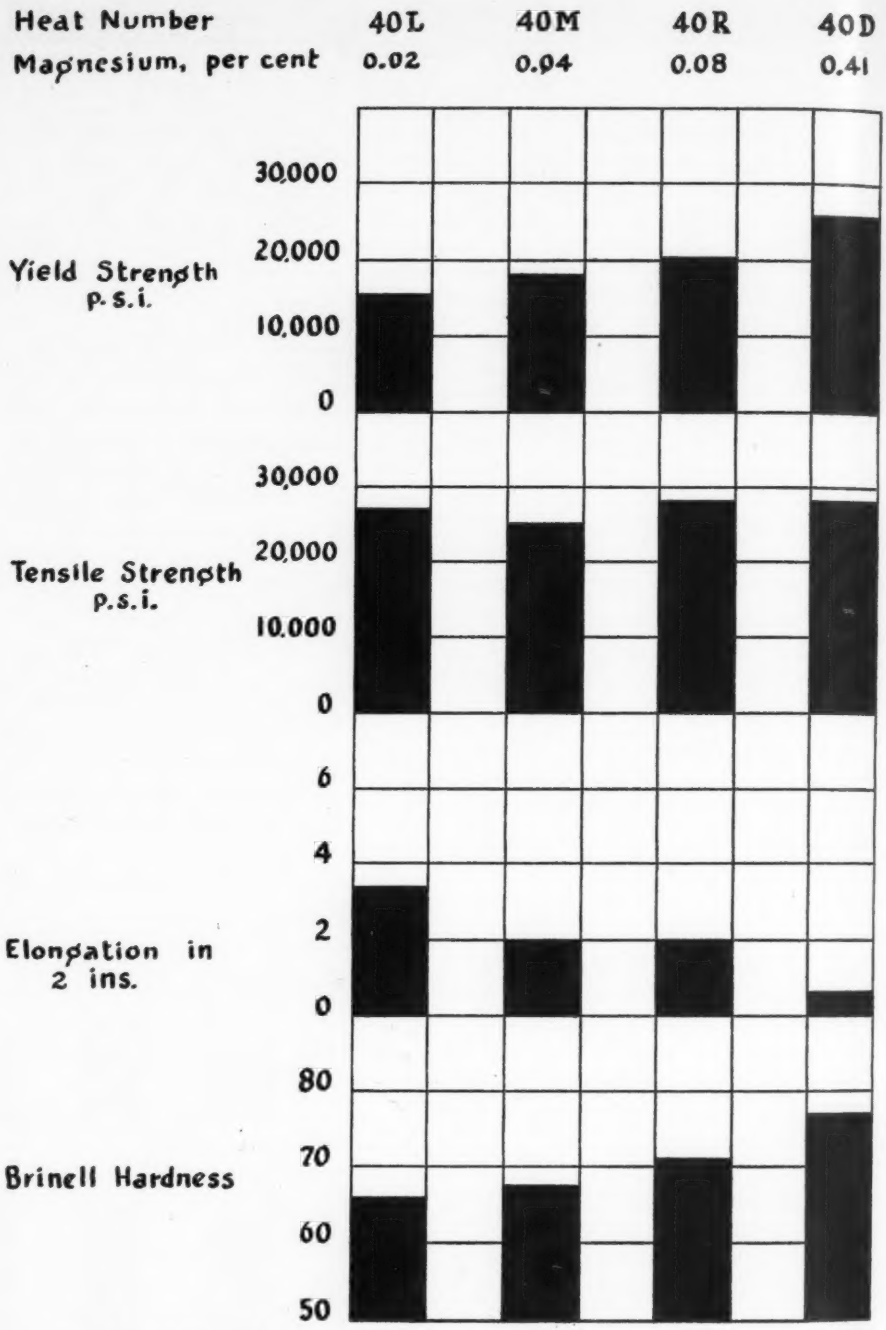


Fig. 2—Effect of Magnesium Content on the Properties Developed by Alloy No. 18 After Being Cast and Stress Relieved at 450°F. for 5 Hours.

Heat Treatments

The possible heat treatments which may be applied, consist of annealing, stress relieving, or full solution heat treatment and artificial aging. Figure 1 shows results obtained for the extreme ranges of analyses utilizing these three treatments. The cycles used are shown in Table 4. The yield strength, tensile strength, elongation, and hardness are markedly affected by these three treatments. Annealing, regardless of analysis, tends to result in low yield strength, low hardness, and also tends to lower the tensile strength and increase the elongation. The tendency toward raising the elongation is only perceptible with low impurities. By comparison, both stress relieving and solution heat treating and artificial aging result in higher yield strength, tensile strength, and hardness, and only slightly lower elongation in the case of the stress relieving.

It has been proved that stress relieving satisfactorily relieves casting and cold working

stresses and also eliminates the possibility of further age hardening due to precipitation.

In Sperry equipment, a reasonably high yield point is a basic requirement, and it is believed that 15,000 p.s.i. is a reasonable minimum figure. This is 75 per cent of that obtained on alloy No. 14, twice that obtained with alloy No. 12, and 50 per cent higher than alloy No. 11. Sperry Alloy No. 2, which has been considered satisfactory for many years, in the stress relieved condition, results in a yield point of approximately 18,000 p.s.i., which is an average figure. Referring again to Fig. 1, it can be seen that, regardless of composition, a 15,000 p.s.i. minimum yield strength can be achieved by the use of a stress relieving treatment and that other properties appear satisfactory. It is also evident that if the solution treatment and artificial aging procedure were to be used, more specific control of the magnesium content would be required, resulting in more difficult operation, particularly in sub-contractors' foundries.

Effect of Magnesium

Consequently specific attention was paid to stress relieved properties. Figure 2 presents this graphically in connection with the effect of magnesium. It should be pointed out that the last column, heat 40D, is outside the limits of our proposed specification. It will be seen from this chart that throughout the range of analyses which we intend to employ, satisfactory physical properties can be obtained.

Stress-Strain Data

Figure 3 gives the stress-strain data on all the aluminum alloys investigated up to the breaking point. It will be noticed that the straight silicon alloys show higher elongations and lower strengths than alloys Nos. 2, 14, and 18. We are, however, more interested in the portions of the curve representing elastic deflection. This section of Fig. 3 has been enlarged to form Fig. 4. The alloy No. 14 curve is the highest of the group. The alloy No. 2 curve falls between two curves representing average and minimum results on the new alloy No. 18, whereas the silicon alloys Nos. 11 and 12 fall below this range. This would tend to indicate that the elastic properties of the new secondary alloy will be as satisfactory as those of our present alloy No. 2. Curves for both alloys represent the stress relieved condition.

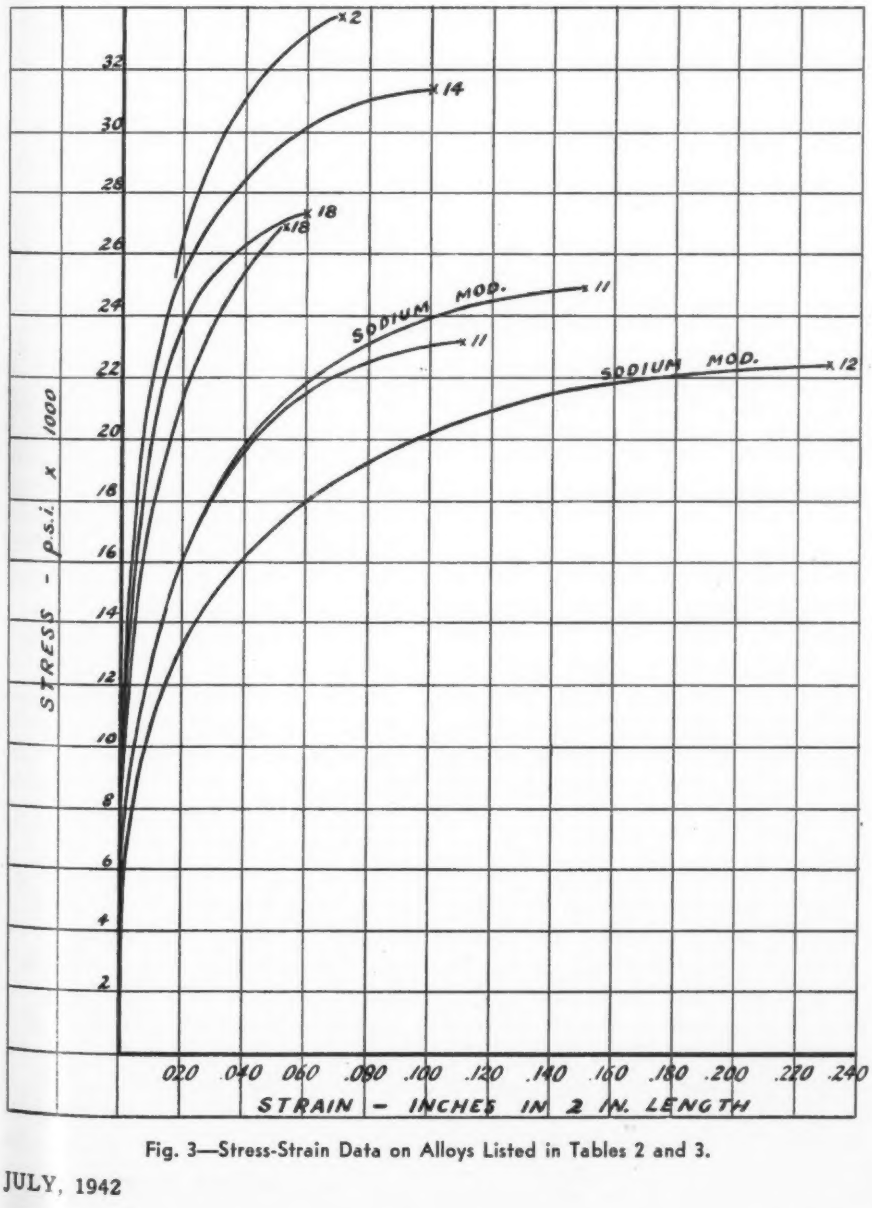


Fig. 3—Stress-Strain Data on Alloys Listed in Tables 2 and 3.

Other Properties

On the basis of the castings which were made, satisfactory foundry properties in the range covered by our analysis are assured. Machinability appears satisfactory so far as can be learned from the castings which have been processed. There has been insufficient time to complete tests on the shock resistance of this material.

Alloy No. 18 anodizes very well by both sulfuric acid and chromic acid processes. Salt spray testing is, at the time of the writing of this paper, incomplete. However samples anodized by both sulfuric and chromic acid methods show no signs of corrosion in 20 per cent salt spray after 720 hours in the case of sulfuric acid process, and 300 hours in the case of the chromic acid process.

Air-Hardening Properties

It was found that alloy No. 18 air hardens after casting, the degree of air hardening being greater the higher the magnesium content. This air hardening adversely affects the ability of a casting to stand straightening

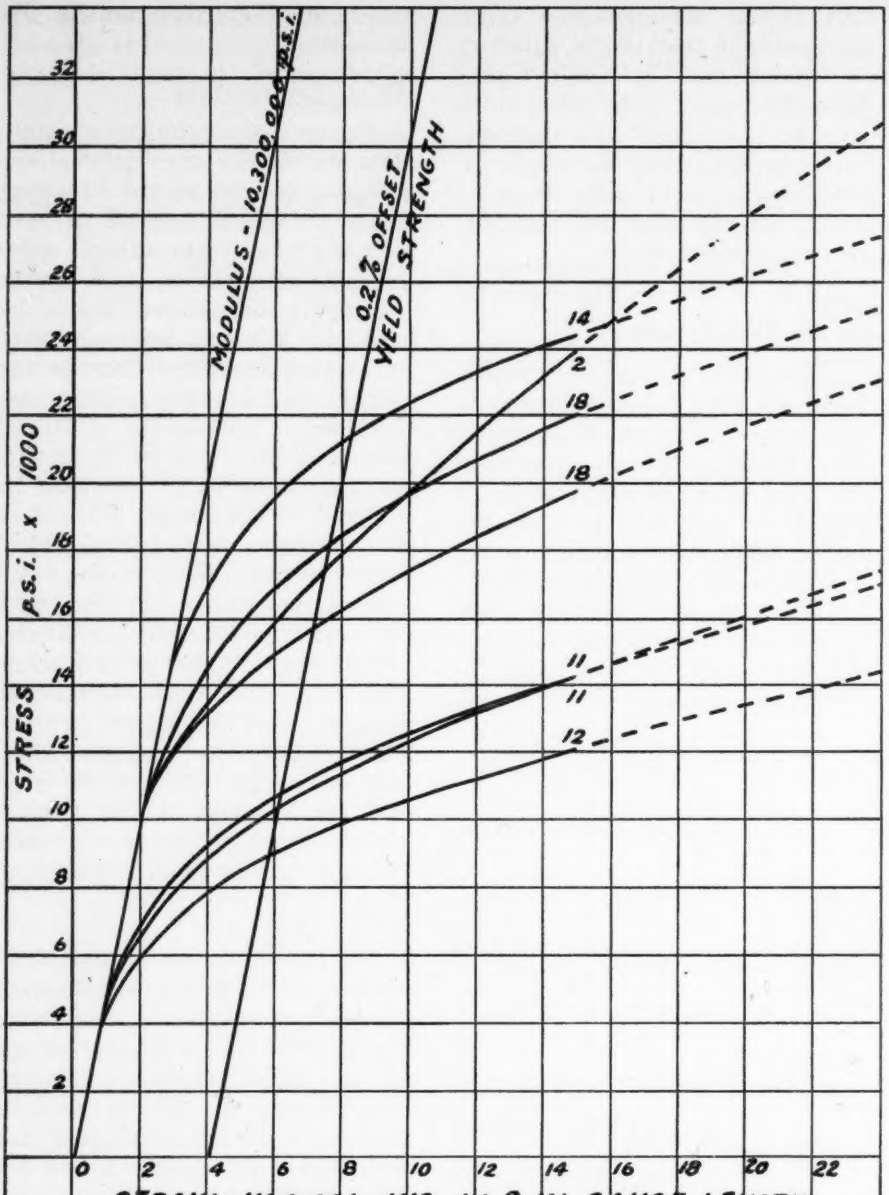


Fig. 4—Stress-Strain Data for Alloys of Tables 2 and 3 in the Elastic Region.

and as a result straightening must be done before much air hardening has occurred. In the range of 0.01 to 0.10 per cent magnesium, this means before the casting has aged one week.

Table 5 shows the effect of air hardening on the mechanical properties of material having 0.01 to 0.10 per cent magnesium. It also gives a comparison of various air hardening properties and those obtained by heat treatment for 1 hour at 750°F. and for 5 hours at 450°F. It will be noted in the chemical analysis of heat 40Q (the material having 0.01 per cent magnesium) that the copper is 4.12 per cent and the silicon is 2.15 per cent. A rather complete investigation of material having these copper and silicon contents has been carried out, the results of which are not given in detail in this paper. The results of heat 40Q are presented because this heat has the lowest magnesium content of any secondary metal investigated.

Micro-structure

The micro-structure of alloy No. 18 was examined to determine if any correlation could be found between micro-structure and mechanical properties.

Figure 5, at 100x, shows the micro-structure of a test bar of heat 40K, two weeks old. This is the typical structure of alloy No. 18. Room temperature aging or heat treatment at 450°F. has no effect on this micro-structure.

Figure 6, at 100x, shows the micro-structure of a test bar of heat 40B containing 0.16 per cent magnesium. This needle-like structure has been noted on the examination of several brittle castings that have broken in straightening. All of these castings contained magnesium in excess of 0.10 per cent.

Figure 7, at 500x, is the same as in Fig. 6. This shows that the needle-like structure is caused by the presence of narrow plates, the composition of which is unknown to the writer.

Figure 8, at 500x, shows alpha-iron-aluminum-silicide scrip present in heat 40D. The presence of a large amount of this material lowers the ductility of the metal but to a lesser extent than results from the presence of the needle-like structure caused by excessive magnesium content.

Conclusions

It has been found that, with proper foundry technique and care, satisfactory castings can be produced from alloy No. 18 having a basic composition of 3 per cent copper, 4 per cent silicon and 0.10 per cent maximum magnesium. An alloy having a basic composition of 4 per cent copper, 2 per cent silicon and 0.10 per cent maximum magnesium is much more available in the market, has nearly the same mechanical properities and foundry characteristics, but does not lend itself so well to the casting of exceedingly intricate parts.

The most important mechanical property to be considered in changing from a primary alloy to a secondary alloy is yield strength, and every effort should be made to evaluate yield strength in physical testing of secondary alloys.

A minimum elongation of 1.5 per cent has been found to be essential in the production of useful castings. This is predicated on what is required of the metal in use, rather than on what can be easily obtained from the metal in the foundry.

The T6, or high temperature solution heat treatment, is not

Table 5

Effect of Magnesium on Air-Hardening Properties

Heat No.	*Treatment*	*Yield Strength, p.s.i.*	*Tensile Strength, p.s.i*	*Elongation, Per Cent in 2-in.*	*BHN*
40 P	1 day old	13,810	26,890	2.5	62
		15,780	26,490	2.5	63
40 P	1 week old	18,300	28,820	2.5	71
		18,600	27,650	2.5	72
40 P	2 weeks old	18,480	28,710	2.5	72
		18,080	28,740	2.5	74
40 P	1 month old	20,480	25,350	1.5	73
		18,800	27,570	2.0	74
40 P	4 hours at 450°F.	20,970	29,500	1.5	75
		22,430	29,250	1.5	77
40 P	1 hour at 750°F.	11,270	25,560	3.0	61
		11,950	24,130	2.5	62
40 Q	1 day old	12,830	25,650	4.0	60
		12,030	25,310	3.5	60
40 Q	1 week old	12,880	26,500	3.0	65
		14,360	26,500	3.0	65
40 Q	2 weeks old	16,000	23,950	2.5	66
		15,660	26,750	3.0	66
40 Q	1 month old	16,540	27,570	2.5	68
		17,130	27,416	2.5	67
40 Q	5 hours at 450°F.	16,870	27,230	2.0	65
		18,230	27,720	2.5	67
40 Q	1 hour at 750°F.	11,130	22,740	3.0	58
		11,930	25,360	4.0	60

recommended for the copper-silicon type secondary metal. This type of heat treatment will give great variations in mechanical properties as the result of the large variation in the amount of impurities that may be present. A simple heat treatment of 5 hours at 450°F., followed by cooling in still air, is recommended as the best possible heat treatment for this alloy. This treatment will consistently result in a yield strength of over 15,000 p.s.i. and will give much less variation in mechanical properties as affected by impurities present.

Change-Over Difficulties

There are many difficulties to be overcome in the foundry when changing from primary alloys to secondary alloys of the copper-silicon type. They are listed as follows:

A. Dross and Oxide Inclusions

Secondary aluminum may contain more oxides than primary metal. The effects of these oxides, namely lower ductility, can be kept to a minimum by the use of proper fluxes in melting. Any of a number of commercial fluxes will do. All gates and risers must be remelted and cast into ingots before being reused.

B. Magnesium Contamination

Magnesium is the most harmful impurity present in alloy No. 18. The top limit has been set at 0.10 per cent. This is the absolute top limit that can be tolerated, and every effort must be exercised to prevent the contamination of alloy No. 18 with other magnesium bearing alloys. The remelt ingot must be analyzed for magnesium.

C. Increased Shrinkage

Alloy No. 18 shows a greater tendency to shrink from the liquid to the solid than do the silicon alloys. Risers and chills are very effective with this alloy and must be used in greater abundance. Great care must be used in changing to alloy No. 18 to see that enough additional risers are used to produce solid castings.

Fig. 5—Microstructure of Heat 40K, Two Weeks Old, 100x.

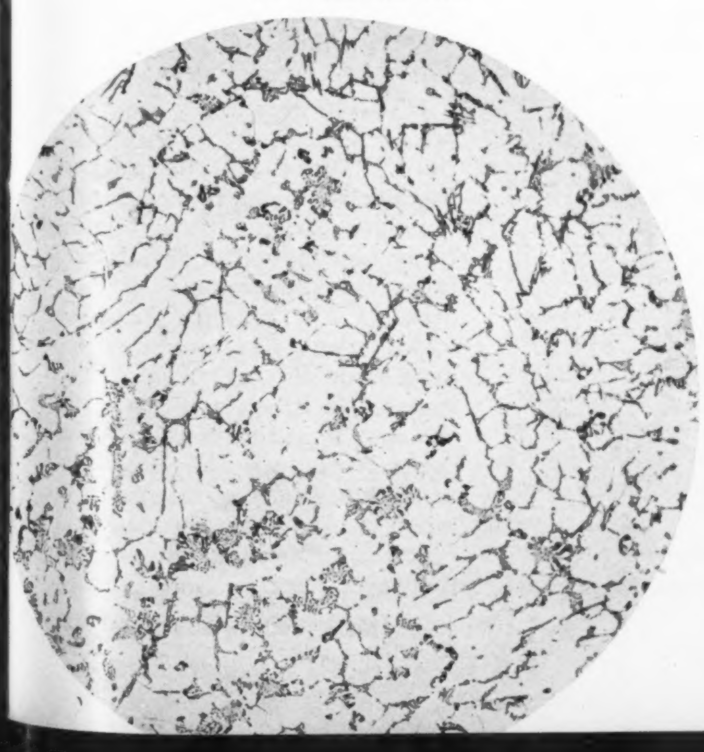
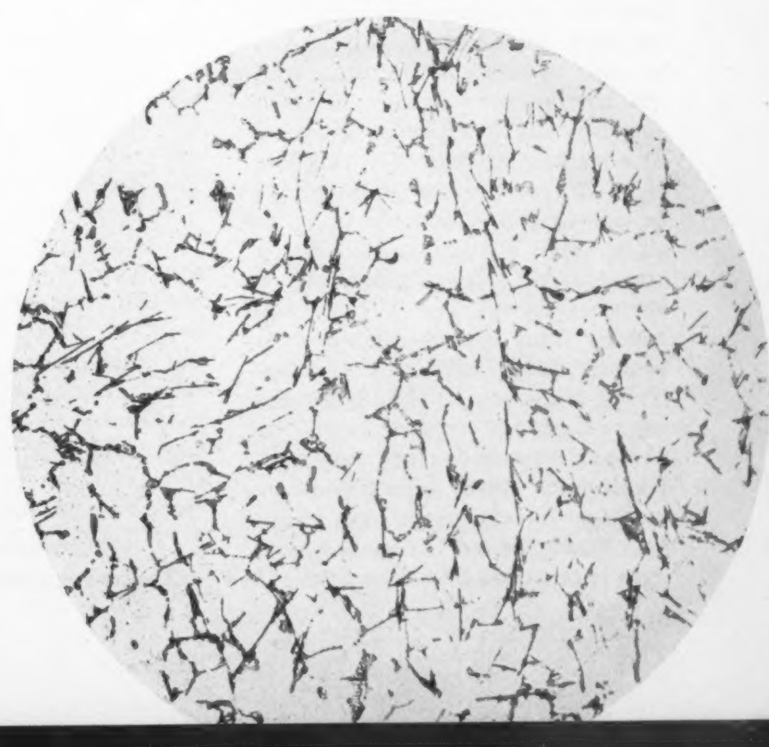


Fig. 6—Microstructure of Heat 40B Containing 0.16 Per Cent Magnesium. 100x.



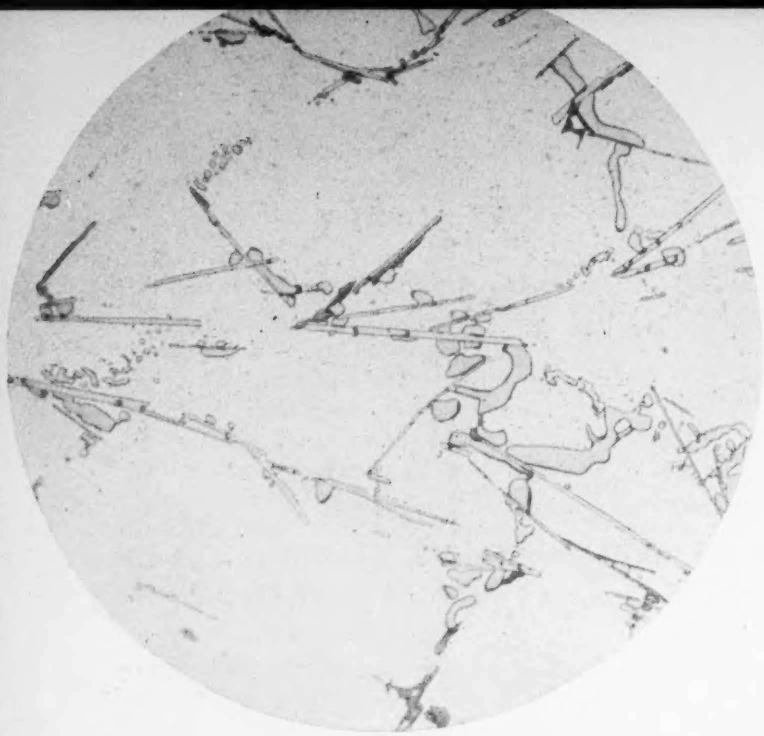


Fig. 7—Same as Fig. 6, but at 500x.

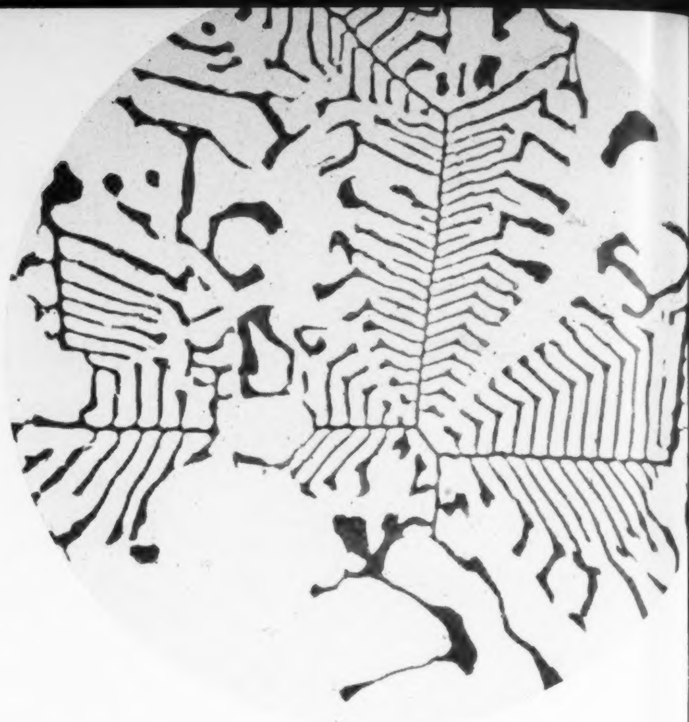


Fig. 8—Micrograph Showing the Alpha-Iron-Aluminum Silicide Present in Heat 40D. 500x.

D. Grain Coarsening

Alloy No. 18, like many other aluminum alloys, is subject to grain coarsening when poured at high temperatures, which in turn results in lower ductility. As alloy No. 18 has very little ductility when properly made, every care must be taken not to overheat the metal and to use such gating as to make possible the pouring of the castings at the lowest possible temperature. Good results have been obtained by not exceeding 1350°F.

E. Low Ductility As Affecting Straightening

Castings of alloy No. 18 can be properly straightened. However, this alloy air-hardens for about a month after casting. In a month, the yield strength will increase from about 12,000 p.s.i., as-cast, to about 20,000 p.s.i; and the hardness will increase from about 60 to 70 Brinell. Most of this hardening occurs in the first week. Therefore, castings should be straightened as soon as possible after pouring. After straightening, castings should be stress relieved for 5 hours at 450°F. This causes the alloy to become fully hardened and relieves stresses due to straightening. Castings cannot well be straightened after this heat treatment. Every effort must be made to have the castings properly straightened before they are heat treated; otherwise, if straightening is required at the time of machining, many cracked castings will result.

Control of Secondary Material

Remember that so called "secondary" does not mean "pots and pans." It is an alloy which is a compromise between many factors, chiefly availability and mechanical properties. As such, it must be treated with respect and more carefully handled than primary materials. Therefore, these are the important points:

A. Analysis must be controlled.
B. Melting Practice must be better than average.
C. Molding should be liberal in use of risers and chills.
D. Straightening must be carefully and completely done as soon as possible after removal from the sand.
E. To insure satisfactory performance, castings must be stress relieved but cannot be straightened after this treatment.

The difficulties encountered in the foundry in the use of secondary alloy, as listed above, should be given every consideration by the designer of parts to be cast from this alloy. Every effort should be made to design parts requiring a minimum amount of straightening or bending in fabrication and use.

Acknowledgments

The writer wishes to express deep appreciation to the members of the Sperry Materials Laboratory and Foundry for help and guidance in this work, especially to R. W. Waring for direction, to W. M. Jung for micrographs, to W. C. Spiess for anodizing tests, to D. M. Kendall for physical tests and to A. Schlagenhauf and W. A. Cabre for fullest foundry cooperation.

Appoint Gen. Campbell New Chief of Ordnance

MAJOR General L. H. Campbell, Jr., formerly Assistant Chief of Industrial Service, the Production branch of Office of the Chief of Ordnance, Washington, D. C., recently was appointed Chief of Ordnance, succeeding Major General C. M. Wesson.

It will be recalled by those who attended the 1942 A.F.A. Convention in Cleveland, that General Campbell addressed the opening meeting April 20, outlining the tremendous importance of castings in ordnance work. His address, "Castings for Ordnance Production," was printed in the June issue of "American Foundryman." In it he stated that after the last war the trend in ordnance design was away from cast parts, but due to great improvements made in cast metals in recent years, the trend now is more than ever back to castings.

The Systematic Training of Foundry Apprentices

By George A. Zabel,* Oshkosh, Wis.

This is the third in a series of articles prepared by a member of the Apprentice Training Committee concerning today's all important job of training skilled workmen for the foundry industry. The two previous articles appeared in the January and February issues of American Foundryman. The author in this article points out how their apprentices are trained and the time required to complete the course. Some new and interesting facts on apprentice training are revealed.

APPRENTICE training, at the Universal Foundry Co., Oshkosh, Wis., is one phase of a long time, general personnel training program. An early systematic training of young men (training them to our needs) seems to be worth all the effort we have given to it.

Prospective apprentices are selected from students enrolled at the local vocational school, and are usually chosen from groups that have had a high school education. Basis upon which final selection rests is the boy's school record, recommendations of instructors or business men, personal interview, and the results of two examinations. One examination is principally a basic mathematical test with foundry terms injected. The other is the Revised Minnesota Paper Form Board Test, Series A.A. Where a student has a previous test record, no further test is made, except that the basic mathematical test is always given. The results of these tests are not necessarily evidences of acceptance or rejection, but rather are administered to give us light in which direction the boy needs further academic training or review.

Figure 1 illustrates the phases of foundry training the apprentice receives, and the intensity of training is shown by the number of hours spent on each job. This program is based on a forty hour week and fifty full weeks of work for a total of 8000 hours. If the apprentice works without lay-offs or works overtime, he can finish his training short of four years.

Figure 1 illustrates only the apprentice molder's training program. We do have one apprentice patternmaker who is given training in all the essential patternmaking operations necessary to the kind of work we make.

A probationary clause is inserted in the contract between the company and the apprentice. If for legitimate reasons either party wishes to abrogate the agreement within three months of the time it goes into effect, that party may do so without penalty.

The apprentice first works in the pattern vault. It is felt that this is the logical place to start an apprentice since it is here that he is quickly made acquainted with the various kinds of pattern and core box equipment (Fig. 2) with which he will be in constant contact throughout his apprenticeship. At the outset he is taught to have a respect for costly equipment. In delivering patterns and core boxes to the molding floors and core department he becomes familiar with other departments of the foundry and with the men in those departments.

Name ______________________

Job	Hours Required	Date From	To	Hours Worked	Actual Earnings	Cost of Training
A. Pattern Storage	160					
B. Core Room						
1. Making Dept.						
a. Mix core sand	80					
b. Small cores	200					
c. Large Cores	120					
d. Small Machine	120					
e. Booking	760					
f. Green halfing	80					
g. Jacket Work	240					
2. Assembly Dept.						
a. Unload core racks	40					
b. Clean & Paste core	160					
c. Assemble	160					
d. Inspection	40					
C. Molding						
1. Bench (loose work)	760					
2. Machine						
a. Hand squeezer (Plate & Hard match work)	440					
b. Jolt and Squeezer	680					
c. Power squeezer	680					
d. Jolt, Rollover, Strip, Bumper	440					
3. Floor Molding	1000					
D. Cleaning Room						
1. Stand Grinder	160					
2. Hand Grinder	120					
3. Tumbling Mills	160					
4. Chipping	120					
5. Sand Blast	40					
6. Pull Wires & Water Test	120					
7. Scrap Analysis	80					
E. Casting Inspection and Shipping	80					
F. Maintenance	160					
G. Cupola						
1. Distribute Iron to Molding Floors	80					
2. Make up charges	160					
3. Charging	80					
4. Tapping	80					
5. Line and Patch Ladles	80					
6. Clean up Drop, Chip out Cupola, Line Cupola, Make up Sand-Bottom	320					
TOTAL HOURS	8000					

Fig. 1—The phases of foundry training the apprentice receives.

*Assist. Supt., Universal Foundry Co., and Member, Apprentice Training Committee.

After working in the pattern vault he is routed through the various jobs in the core department, beginning with sand mixing.

In the molding department he works with the facing man and does sand testing (Fig. 3) before he does any molding. Then in succession he goes to small machine, bench, large machine, and floor molding.

Training in the finishing and inspection department is followed finally by experience in the melting department. Here the young man is taught to pick up and gauge the melt for the day. At this time also, he learns about the make-up of alloy combinations and prepares the same for the day's run. Next he is placed on distribution and pouring of iron, charging and tapping-out coming last in the training in this department.

The apprentice's practical training is correlated with technical training. All apprentices are required to attend school four hours weekly, during which time they receive technical and other instruction closely related to their current job. This instruction includes related foundry subjects, foundry math, foundry drawing, and industrial social studies.

Instruction is given by a foundry circuit instructor, who travels from city to city under the joint sponsorship of the several vocational school boards. The foundry instructor comes to the local vocational school every Wednesday to work with apprentices in the afternoon and adults in the evening. The instructor is a practical foundryman trained in teaching foundry practice.

At the conclusion of his apprenticeship the learner receives a bonus. This is compensation for his good will in bringing his apprenticeship to a successful conclusion. He can earn other bonuses during his periods in the molding departments. He can do this by maintaining a low scrap record.

Fig. 2—(Top) Apprentice working in the pattern shop. Fig. 3—(Bottom) Sand testing also is learned by apprentices.

Once a month apprentices meet at the plant to discuss closely related foundry problems, and also to meet socially. Speakers on foundry problems as well as speakers on social and civic activities are brought in to talk. Among the speaker group, foremen from the plant are important lecturers.

The progressive time spent on each job is shown graphically in Fig. 4. This tells at a glance when the apprentice is about ready to be moved to another job. The actual time spent on the job, which may vary 21 hours before or beyond the contract hours, is recorded in columns 2 and 3 of Fig. 1. The apprentice supervisor also keeps a larger chart showing at a glance where all apprentices are stationed.

A record is kept of apprentice earnings and production value for the purpose of ascertaining what our apprenticeship program costs. This is recorded in columns 4 and 5 of Fig. 1.

On the reverse side of Fig. 1 is a rating chart (Fig. 5). When

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SCHEDULE OF PROCESSES TO BE WORKED:

A.	Pattern Storage		160
B.	Core Room - 1. Making Department		
		a. Mix Core sand	80
		b. small cores	200
		c. large cores	120
		d. small machine	120
		e. booking	760
		f. green halfing	80
		g. jacket work	240
	2. Assembly Department		
		a. unload racks	40
		b. clean and paste	160
		c. assemble	160
		d. inspection	40
C.	Molding - 1. Bench (Loosework)		760
	2. Machine		
		a. Hand squeezer(Plates & hard sandmatches)	440
		b. jolt squeezer	680
		c. power squeezer	680
		d. Jolt,R.O.,Strip,Bump	440
	3. Floor molding		1000
D.	Cleaning Room 1. Stand Grinder		160
	2. Hand grinder		120
	3. Tumbling mills		160
	4. Chipping		120
	5. Sandblast		40
	6. Pull Wires & water test		120
	7. Scrap Analysis		80
E.	Casting inspection & shipping		80
F.	Maintenance		160
G.	Cupola - 1. Distribute iron		80
	2. Make up charges		160
	3. Charging		80
	4. Tapping		80
	5. Line & patch ladles		80
	6. Clean up drop, chipout cupola line cupola, makeup sand.bot.		320

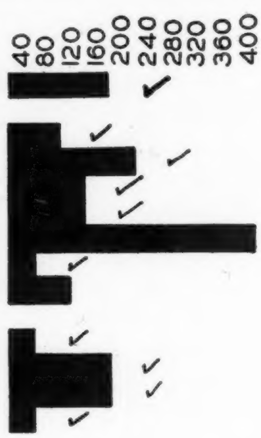

Fig. 4—Graph showing the time an apprentice spends on each job.

APPRENTICE RATING CARD

Name ______________________ Job ______________________

Classification ______________ Date of Rating ____________

TRAIT	DESCRIPTION				SCORE
Ability to Learn	Slow 1 2 3	Fair 4 5 6 7	Quick 8 9 10		
Judgment	Poor 1 2	Average 3 4 5	High 6 7 8	Unusual 9 10	
Ability to Work with Others	Non-Coop. 1 2	Coop. Occasionally 3 4 5 6 7	Always Coop. 8 9 10		
Ability to take Orders	Ques. Orders 1 2 3	Usually Obeys 4. 5 6	Always Accepts 7 8 9 10		
Safe Worker	Dangerous 1 2	Average 3 4 5 6	Careful 7 8 9 10		
Quality of Work	Poor 1 2 3	Satisfactory 4 5 6 7	Above Ave. 8 9 10		
Quantity of Production	Poor 1 2 3	Satisfactory 4 5 6 7	Above Ave. 8 9 10		
Care and Use of Property	Careless 1 2 3	Thoughtless 4 5 6	Careful 7 8 9 10		
Desire to make Good	Low 1 2 3	Noticeable 4 5 6 7	Pronounced 8 9 10		
General Conduct	Discourteous 1 2 3	Coarse 4 5 6	Courteous 7 8 9 10		
Loyalty	Lacking 1 2	Fair 3 4	Good 5 6 7 8	High 9 10	
Personal Traits	Dirty 1 2 3	Fairly Neat 4 5 6	Neat 7 8 9 10		
Reliability	Needs Watching 1 2 3 4	Fairly Reliable 5 6 7	Reliable 8 9 10		
Punctuality	Often Late 1 2	Late very few times 3 4 5 6 7	Always on time 8 9 10		
Thoroughness	Careless 1 2	Fairly Thorough 3 4 5 6 7	Very Thorough 8 9 10		

RATING ______

Remarks:

Rated by ______________________

Fig. 5—An apprentice rating card filled out by the foreman when the apprentice completes his training in the foreman's department.

the apprentice completes his training in a department, the foreman is asked to rate him. At the conclusion of his apprenticeship we have a fair idea of how the apprentice stands with respect to the factors shown in Fig. 5.

The program is bearing fruit, and we are satisfied that we are doing the right thing by making apprenticeship training a part of our personnel training program. We consider apprenticeship training a far-reaching and worthwhile investment.

"Job Instructor Training" Gives A.F.A. Chapters Big Opportunity

A SPLENDID new opportunity for lending direct aid to war production work was recently presented to all A.F.A. chapters by officers of the Association. Chapter chairmen have been urged to cooperate with district representatives of the War Production Board in bringing the W.P.B. "Job Instructor Training" program to the attention of foundry executives all over the country.

Thoughtful industrial leaders frankly admit that one of the largest headaches of industry is the problem of training a vast army of new workers to do their jobs quickly and competently. It has been estimated that only one million skilled workers are available today to train this great new production army, thousands of whom are entering the ranks of industry every day, and yet few of these million skilled workers are skilled instructors.

Streamlined Training Method

Here is where the Job Instructor Program, or "J.I.T." as it is known familiarly, comes into the picture. J.I.T. is a ten-hour streamlined, standardized training procedure whereby skilled workers are trained to convey their skills to others in their plants, and to do so correctly, quickly and efficiently. The system is based on the very practical and sound idea that the best instructor for mechanical work is the skilled worker himself, when trained properly to tell others what he knows.

J.I.T. applies equally to any plant or any industry, regardless of how technical or complicated its operating procedure. In fact, the technicalities of the job are not involved in the training plan. J.I.T. simply trains those who do know the technicalities how to pass their information and experience on to others. The principles behind it have been used in American industry for the past quarter century, having been first tried out successfully during World War I.

Proven in Industry

The present plan was worked out by leaders in industrial training, loaned to W.P.B. for the purpose, together with Federal and state representatives for vocational training. The actual training of job instructors in the plants is given by experienced industrial men, specially trained for the work.

J.I.T. is given without cost to all companies holding war production contracts or sub-contracts. Approximately 4,000 industrial plants have already adopted the plan, with the result that over 100,000 foremen, super-

visors and lead men have been trained in J.I.T., with notable success in reducing the time required for training new workers to full production effort.

A.F.A. sponsorship of the plan for foundries was first sought at a meeting held in Chicago, June 4, and it is hoped that through chapter cooperation with W.P.B. district representatives the plan will be widely adapted to the castings industry. One meeting, sponsored by the Wisconsin Manufacturers Association, has been called for July 15 in Milwaukee, to which Wisconsin foundrymen are being invited.

A.S.T.M. Issues Emergency Alternate Provisions on Steel Castings Standards

TO cover the situation which has arisen, due to the below normal availability of certain materials, the American Society for Testing Materials has issued two new types of specifications. The first is termed "Complete Emergency Specifications" and the second is termed "Emergency Alternate Provisions to Specifications." The Emergency Specifications will carry the designation ES, for example ES-1, ES-2, etc. The Emergency Alternate Provisions carry the designation EA-A27, EA-A87, etc.

Modifications made in the steel castings specifications have been suggested by the Steel Founders' Society of America and have been adopted by A.S.T.M. Committee A-1 on Steel. Several of the provisions suggest modifications in chemical and physical properties which will bring the requirements in line with other specifications, particularly Federal Specification QQ-S-681b and proposed Navy specifications.

The Emergency Alternate Provisions for Steel Castings Specifications A27, A87, A148 and A215 are listed below.

EA-A 27

Issued, February 24, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for Carbon-Steel Castings for Miscellaneous Industrial Uses (A27-39) and affect only the requirements referred to:

Section 3(d).—Change the last sentence to read as follows:

No casting so treated shall be removed from the furnace until the pyrometer indicates that the entire furnace charge has fallen to a *temperature of 750 F. (399 C.), or lower, unless otherwise specified by the purchaser.*

Section 5.—Delete the requirement for maximum manganese permitted.

Section 8(a).—Add the following as footnote "b" to Table I, applying to grades A-3, B-1, B-2, and H-1:

b Unless full annealing is specifically requested in the inquiry, contract, or order, castings made in grades A-3, B-1, B-2 and H-1 may be given a normalize treatment followed by a draw treatment instead of the full anneal treatment.

Table I.—Change the minimum physical requirements for grade B-2 to the following:

TABLE I.—PHYSICAL REQUIREMENTS.

	Tensile Strength, min., psi.	Yield Point, min., psi.	Elongation in 2 in., per min., cent	Reduction of Area, per min., cent
Grade B-2.........	65 000	35 000	20	30

EA-A 87

Issued, February 24, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for Carbon-Steel and Alloy-Steel Castings for Railroads (A87-36) and affect only the requirements referred to:

Section 3(d).—Change the last sentence to read as follows:

No casting so treated shall be removed from the furnace until the pyrometer indicates that the entire furnace charge has fallen to a *temperature of 750 F. (399 C.), or lower, unless otherwise specified by the purchaser.*

Section 9(a).—Change the first sentence to read as follows:

One or more test coupons sufficient in size and number to provide the required test specimens shall be cast attached near the end of each locomotive frame, to each locomotive cylinder, to each wheel center, and to each other casting, *where practicable, weighing over 500 lb. each,* except as otherwise specially provided for in these specifications.

Also in Section 9*(a)* change the last sentence to read as follows:

In the case of orders for castings weighing under *500 lb. each,* the physical properties required in Table I shall be determined from an extra or spare test coupon cast attached to another casting from the same melt.

EA-A 148

Issued, February 24, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for Alloy-Steel Castings for Structural Purposes (A148-36) and affect only the requirements referred to:

Section 1.—Change the reference to Class C to read as follows:

Class C.—Castings of *four grades,* which may be liquid quenched and tempered or drawn (Note 3).

Table I.—Add the following minimum physical requirements for a new grade 4 of Class C castings:

TABLE I.—PHYSICAL REQUIREMENTS.

	Tensile Strength, min., psi.	Yield Point, min., psi.	Elongation 2 in., in min., per cent	Reduction of Area, min., per cent
Class C, Grade 4....	105 000	85 000	18	40

EA-A 215

Issued, February 24, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for

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List of Emergency Alternate Provisions

Issued, April 28, 1942

Designation	*Title*
EA-A 27	Carbon-Steel Castings for Miscellaneous Industrial Uses.
EA-A 87	Carbon-Steel and Alloy-Steel Castings for Railroads.
EA-A148	Alloy-Steel Castings for Structural Purposes.
EA-A215	Carbon-Steel Castings Suitable for Fusion Welding for Miscellaneous Industrial Uses.
EA-A216	Carbon-Steel Castings Suitable for Fusion Welding Service at Temperatures up to 850 degrees Fahrenheit.
EA-A217	Alloy-Steel Castings Suitable for Fusion Welding for Service at Temperatures from 750 to 1100 degrees Fahrenheit.
EA-B 30	Copper-Base Alloys in Ingot Form for Sand Castings.
EA-B 60	Castings of the Alloy: Copper, 88 per cent; Tin, 8 per cent; Zinc, 4 per cent.
EA-B 62	Composition Brass or Ounce Metal Castings.
EA-B143	Tin-Bronze and Leaded Tin-Bronze Sand Castings.
EA-B144	High-Leaded Tin-Bronze Sand Castings.
EA-B145	Leaded Red Brass and Semi Red Brass.
EA-B148	Aluminum-Bronze Sand Castings.

Carbon-Steel Castings Suitable for Fusion Welding for Miscellaneous Industrial Uses (A215-41) and affect only the requirements referred to:

Section 1(b).—Change to read as follows:

(b) Five grades are covered, as indicated below, the grade desired to be specified by the purchaser:

Grade EN-1-W not required to be physically tested, nor to be heat-treated except as conditionally provided for in Section 13*(b)*.

Grade EN-2-W not required to be physically tested, but required to be full annealed, normalized, or normalized and drawn.

Grade EA-1-W required to be physically tested, but not required to be heat-treated except as conditionally provided for in Section 13*(b)*.

Grade EA-2-W required to be full annealed, normalized, or normalized and drawn and to be physically tested.

Grade EB-W required to be full annealed, normalized, or normalized and drawn and to be physically tested.

Section 3(a).—Change to read as follows:

3. *(a).* A heat treatment (Note 3), either by full annealing, normalizing, or normalizing and drawing at the option of the manufacturer, shall be applied to all castings of grades EN-2-W, EA-2-W, and EB-W. Castings of welding quality shall not be cooled from above the critical range by liquid quenching, liquid spraying, or air blasting. Unless otherwise specified, all castings may be annealed one or more times and may be given a supplementary heat treatment by tempering or drawing.

Section 3(d).—Change the last sentence to read as follows:

No casting so treated shall be removed from the furnace until the pyrometer indicates that the entire furnace charge has fallen to a *temperature of 750 F. (399 C.), or lower, unless otherwise specified by the purchaser.*

Section 5.—Change to read as follows:

5. The steel shall conform to the requirements as to chemical composition prescribed in Table I.

TABLE I.—CHEMICAL REQUIREMENTS.

	Carbon, max.,[a] per cent	Manganese, max.,[a] per cent	Phosphorus, max., per cent	Sulfur, max., per cent	Silicon, max., per cent
Grade EN-1-W...	0.25	0.75	0.05	0.06	0.60
Grade EN-2-W...	0.35	0.60	0.05	0.06	0.60
Grade EA-1-W...	0.25	0.75	0.05	0.06	0.60
Grade EA-2-W...	0.30	0.60	0.05	0.06	0.60
Grade EB-W....	0.35	0.60	0.05	0.06	0.60

[a] For each reduction of 0.01 per cent below the maximum specified carbon content, an increase of 0.04 per cent manganese above the specified maximum will be permitted up to a maximum as follows:

	Manganese, max., per cent
Grades EN-1-W, EA-1-W, EA-2-W	1.10
Grades EN-2-W, EB-W	1.00

Table II.—Change to read as follows:

TABLE II.—TENSILE REQUIREMENTS.

	Tensile Strength, min., psi.	Yield Point, min., psi.	Elongation in 2 in., min., per cent	Reduction of Area, min., per cent
Grade EA-1-W, unannealed...	60 000	30 000	22	30
Grade EA-2-W, heat treated...	60 000	30 000	24	35
Grade EB-W, heat treated.....	65 000	35 000	20	30

EA-A 216

Issued, April 6, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Carbon-Steel Castings Suitable for Fusion Welding for Service at Temperatures up to 850°F. (A 216-41 T) and affect only the requirements referred to:

Section 1 (b).—Add two new grades of carbon-steel castings suitable for welding for applications as pressure containing turbine castings, as follows:

Grade EWCC—Grade EWCD

Section 5.—Add to Paragraph *(a)* the following requirements as to chemical composition for Grades EWCC and EWCD:

Grades:	EWCC	EWCD
Carbon, max., per cent	0.30[a]	0.35[a]
Manganese, max., per cent	0.60[a]	0.70[a]
Phosphorus, max., per cent	0.05	0.05
Sulphur, max., per cent	0.06	0.06
Silicon, max., per cent	0.60	0.60

[a] For each reduction of 0.01 per cent below the specified maximum carbon content, an increase of 0.04 per cent manganese above the specified maximum will be permitted up to a maximum of 1.00 per cent.

Add in Paragraph *(b)* the symbols "EWCC" and "EWCD" to the heading of the table, since the requirements of this section apply to the two new grades.

Section 8 (a).—Add the following requirements for grades EWCC and EWCD:

Grades:	EWCC	EWCD
Tensile strength, min., psi	60 000	65 000
Yield point, min., psi	30 000	35 000
Elongation in 2 in., min., per cent	24	20
Reduction of area., min., per cent	35	30

Section 10 (a).—Add the symbols "EWCC" and "EWCD," since the requirements of this section apply to the two new grades.

Section 16 (a).—Add the symbols "EWCC" and "EWCD," since the requirements of this section apply to the two new grades.

EA-A 217

Issued, April 6, 1942

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Alloy-Steel Castings Suitable for Fusion Welding at Temperatures from 750 to 1100°F. (A217-41T) and affect only the requirements referred to:

Section 1 (b).—Add one new grade of alloy-steel castings suitable for welding for pressure containing turbine castings, as follows:

Grade EWC5

Section 5.—Add to Paragraph *(a)* the following requirements as to chemical composition for Grade EWC5:

	Grade EWC5
Carbon, max., per cent	0.30[a]
Managanese, max., per cent	0.70[a]
Phosphorus, max., per cent	0.05
Sulfur, max., per cent	0.06
Silicon, max., per cent	0.60
Nickel, per cent	......
Chromium, per cent	......
Molybdenum, per cent	0.40 to 0.60

[a] For each reduction of 0.01 per cent below the specified maximum carbon content, an increase of 0.04 per cent manganese above the specified maximum will be permitted up to a maximum of 1.00 per cent.

Add to Paragraph *(b)* the following requirements for grade EWC5:

	Grade EWC5
Copper, max., per cent	0.50
Nickel, max., per cent	0.50
Chromium, max., per cent	0.25
Tungsten, max., per cent	0.10
Total content of these unspecified elements, max., per cent	1.0

Section 8 (a).—Add the following requirements for grade EWC5:

	Grade EWC5
Tensile strength, min., psi	65 000
Yield point, min., psi	35 000
Elongation in 2 in., min., per cent	20
Reduction of area, min., per cent	30

Section 17 (a).—Add the symbol "EWC5," since the requirements of this section apply to the new grade.

Certain of the copper base alloy specifications have had alternate emergency provisions issued to them. These alternate provisions are shown in Table 1 below, and in Table 2 on next page.

Table I

New Emergency Compositions for Brass and Bronze Castings
New Designations

		Chemical Requirements								Total Other Constituents, Max.	Tensile Requirements		
Numerical Designation	*Nominal Composition*	*Copper*	*Tin*	*Lead*	*Zinc*	*Nickel, Max.*	*Iron, Max.*	*Antimony, Max.*	*Phosphorus*		*T.S. Min.*	*Y.S. Min.*	*Elong. Min.*
EB143-2X	87-8- 1-4	86-89	7.5-9	1.00 max.	3-5	1.00	0.25	......	0.05 max.	0.35	36,000	16,000	18
EB143-2Y	88-8- 0-4	86-89	7.5-11	0.60 max.	1-5	1.00	0.25	......	0.02 max.	......	40,000	18,000	20
EB144-3X	80-7-10-3	77-81	6-7.5	8-11	2-4	0.50	0.20	0.75	0.05 max.	0.35	25,000	12,000	8
3Y	84-8- 8-0	82-85	7-9	7-9	0.75 max.	1.00	0.15	......	0.2-0.5	0.50	....	....	....
3Z	78-6-15-1	75-79	5.5-7	13-16	1.25 max.	0.75	0.15	0.75	0.08 max.	0.35	25,000	14,000	10
3W	70-5-25-0	67-71	4-5.5	23-27	0.75 max.	1.00	0.15	0.75	0.05 max.	0.35	21,000	11,000	7
EB145-5X	81-3- 7-9*	78-82	2.5-3.25	6-8	7-10	1.00	0.40	......	0.02 max.	0.50	29,000	13,000	18

*Composition identical with B145-5A. Physicals have been raised as compared to B145-5A.

Table 2

Schedule of Proposed Substitutions

Present Designations Spec. No.	Type	Composition Cu	Sn	Pb	Zn		Proposed Substitution Spec. No.	Type	
B 60		88	8		4	For bearings and structural parts	EB143	2X	87-8- 1 -4
								2Y	88-8- 0 -4
						For pressure parts	B143	2A	88-6- 1.50-4.50
B 61		88	6	1½	4½		B143	2A	88-6- 1.50-4.50
							(B61 and 2A identical in composition and physicals)		
B 62		85	5	5	5		EB145	5X	81-3- 7 -9
B143	1A	88	10		2	For pressure parts	B143	2A	88-6- 1.50-4.50
						For bearings and structural parts	EB143	2X	87-8- 1 -4
								2Y	88-8- 0 -4
B143	1B	88	8		4	For pressure parts	B143	2A	88-6- 1.50-4.50
						For bearings and structural parts	EB143	2X	87-8- 1 -4
								2Y	88-8- 0 -4
B143	2A	88	6	1½	4½		B143	2A	(No substitution required)
B143	2B	87	10	1	2		EB143	2X	87-8- 1 -4
B144	3A	80	10	10	0		EB144	3X	80-7-10 -3
								3Y	84-8- 8 -0
								3B	83-7- 7 -3
B144	3C	85	5	9	1		B144	3C	(No substitution required)
B144	3D	78	7	15	0		B144	3Z	78-6-15 -1
B145	4A	85	5	5	5		EB145	5X	81-3- 7 -9
B145	4B	83	4	6	7		EB145	5X	81-3- 7 -9
B145	5A	81	3	7	9		EB145	5X	81-3- 7 -9
B145	5B	76	3	6	15		B145	5B	(No substitution required)

Note: 2X is recommended for large bearings and structural parts. 2Y is recommended particularly for small bearings and bushings as used in internal combustion engines.

Porosity or Segregation in Gray Iron Castings

By Charles Zahn,* Milwaukee, Wis.

The following article is the fifth of a series being prepared by members of the Gray Iron Division Committee on Analysis of Casting Defects. The complete list of defects to be so dealt with was published in the November, 1941, issue of the American Foundryman. In that list Porosity, subject of the present article, is Defect No. 33. The author presents an illustration showing typical dendritic structure in cast iron resulting from porosity, and lists the main causes of this defect as accepted by the committee.

DEFECT No. 33, as accepted by the Committee on Classification of Casting Defects, involves the type of segregation that results in definitely porous castings. Porous castings are those that contain cavities, voids, an open structure, or a deficiency of metal surrounding a dendrite, making the casting unsuitable for the purpose intended. This can be caused by steam or gas passing through the metal or entrapped, with the resulting disturbances and the consequent combinations of shrinks, porosity, segregation or dendritic area.

Fig. 1—Dendritic structure in porous automobile cylinder wall. Enlarged 6X.

This type of defect is a nightmare to all foundrymen, especially in high pressure work, and where light and heavy designed metal sections are incorporated in the same casting.

Porosity is caused mostly by off-metal composition, by improper gating, and very frequently by improper risers or heads.

By improper risers or heads the author has in mind such risers or heads that freeze long before the metal in the casting proper solidifies. Therefore the metal turning to its solids, and having no supply of liquids to take care of the shrinkage, leaves porous or segregated sections. Fig. 1 illus-

*Foundry Superintendent, Vilter Mfg. Co., and member of Gray Iron Division Committee on Analysis of Casting Defects.

†Previous articles on gray iron defects published in American Foundryman: Blows, Dec. 1941 issue; ram off or ram away, Jan. 1942; inclusions, Feb. 1942; scabs and buckles, March 1942.

trates this action, showing the dendritic form or structures.

Causes of Porosity

A. *Due to Design.*
1. In the heaviest section of a casting containing non-uniform sections.
2. Square corners, causing internal shrinkage.
3. Necessary core opening promoting hot spots.

B. *Due to Patterns, Flask Equipment and Rigging.*
1. Absence of or insufficient fillets.

C. *Due to Sand.*
1. Too low permeability.
   a. Too high fines.
   b. Too low grain fineness, or poor grain distribution.
   c. Too high clay content.
2. Too high moisture.
3. Too much carbonaceous or gas producing material.
4. Improperly conditioned sand.

D. *Due to Cores.*
1. Improperly baked cores.
2. Late addition of oil in core before baking, causing hard spots.
3. Improperly vented cores.
4. Improperly sprayed, dipped or coated cores.

E. *Due to Molding Practice, Gating or Risering.*
1. Uneven ramming.
2. Improper venting, green or dry sand mold.
   a. Vent from core to outside smaller than in core.
3. Any combination of hot and cold materials.
   a. Hot flasks and cold sand.
   b. Cold flasks and hot sand.
   c. Hot sand and cold cores.
   d. Hot cores and cold sand.
4. Improper gating.
5. Improper risers and feeding of large sections surrounded by small sections.

F. *Due to Iron Composition.*
1. Metal composition unsuited for sections involved.
   a. Total carbon and silicon too high for the section.
   b. Phosphorus too high, or ratio too high for the various elements.

G. *Due to Cupola Operation.*
1. Interrupted cupola operation, resulting in high total carbons.
2. Fluctuating blast, producing higher total carbon.
3. Erratic late additions of any materials tending to soften or graphitize.

New Protection Code for Chicago Industry

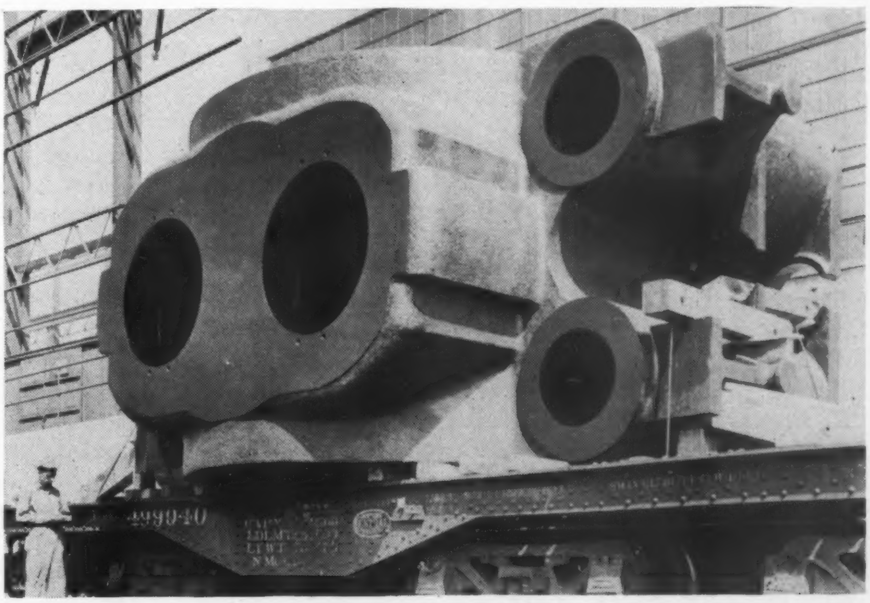
A NEW "Code of Recommended Practices for the Protection of Life, Property and Production in Industry During the War" has just been issued by the Office of Civilian Defense, the Chicago Metropolitan Area. Issued for the guidance of industry particularly in the Chicago area, the code was adapted from that prepared by the A.F.A. Industrial Hygiene Codes Committee, under chairmanship of James R. Allan, International Harvester Co., Chicago.

The Chicago code was issued over the signature of Mayor E. J. Kelly as coordinator of civilian defense in that area, and was adapted under direction of R. H. Burke, deputy coordinator, and P. H. Joyce, chief of industry, Chicago O.C.D. In a "foreword" full acknowledgment is given the A.F.A. Committee for its work in preparing a comprehensive, economical and highly practical set of recommended practices applicable to all industry in safeguarding lives, property and production in wartime.

Mesta Machine Co. Pours World's Biggest Casting

WHEN the Mesta Machine Co., Pittsburgh, poured and shipped from its West Homestead, Pa., works what is claimed to be the largest steel casting ever produced, the event brought forth visual and dramatic evidence of the tremendous part that castings industry is playing in America's war program. The casting poured was a top cap for a 12,000 ton armor plate forging press, also a product of the Mesta firm, and some idea of its size may be gained from the illustration below.

While most details of the job



Shipping what is said to be the world's largest casting, a top cap for a 12,000 ton armor plate forging press. Both the casting and the press were produced by Mesta Machine Co., Pittsburgh, Pennsylvania.

are not available, the pouring operation took approximately 14 minutes, pouring 600,000 pounds of steel from four ladles into one mold. The actual pouring operation is illustrated on the front cover of this issue. Figures on the finished casting weight could not be supplied, since the company had no scale facilities large enough to balance such tonnage.

Mesta Machine Co. is one of the old-time members of A.F.A., having maintained membership since 1903, during the past few years in the name of L. W. Mesta, assistant general superintendent.

Foundry Topics Subject at W.P.B. Conference

REPRESENTATIVES of American Foundrymen's Association and fourteen other technical societies met with officials of the War Production Board in Newark, N. J., May 29 for a special war production conference called at request of W.P.B. The purpose of the meeting was to discuss manufacturing problems arising from the changing over of plants and equipment to war production work.

At a general meeting in the afternoon, conversion problems and shop problems in ordnance, aircraft and naval equipment manufacture were discussed. Speaker at the dinner session was W. H. Harrison, director of production, War Production Board, Washington, D. C., who spoke on "More War Production Today and Tomorrow." In the evening a series of round-table panels were held on shop problems peculiar to foundry production, machine shops, metallurgy, ordnance inspection, substitute materials, welding, and electrical manufacture.

Foundry Industry Backs Cupola Research Project Sponsored by A.F.A. Generously

THREE years ago a group of forward looking members of A.F.A. conceived a plan for increasing the general knowledge of cupola melting throughout the industry. That plan has since broadened into the important Cupola Research Project of the Association. Founded on the fact that the average cupola has been run in the past by "rule of thumb" methods, and that many traditions were being followed which were not based on either good theory or reliable information, the project has received the support of foundries all over the country.

Sponsors of the project requested the Gray Iron Division of A.F.A. to form a committee of highly experienced men in the industry to direct the project. Approval of the A.F.A. Board of Directors was received, with the understanding that the project would be financed through special voluntary contributions on the part of those most interested, since the subject does not affect all members of the Association.

Three Point Program

The committee thus appointed, after studying the subject, proposed the following three-point program:

1. *Review and coordination* of existing published literature. This step has been carried through with the Battelle Memorial Institute, Columbus, Ohio, and the Committee, each contributing $2,000 to pay for the work.

2. *Preparation and publication* of a manual on the Theory and Practice of Cupola Operation. This work is being carried on by the Committee, with more than eighty of the most capable and experienced men of the industry contributing their time and effort. The Committee is divided into eight sub-committees, covering the following phases of the work: (a) Equipment, (b) Pig Iron, (c) Scrap Iron, (d) Alloys, (e) Slags, Fluxes and Desulphurizers, (f) Fuels and Combustion, (g) Operation and Process, and (h) Refractories.

3. *Research work.* In preparing the manual, phases of cupola operation are being found which are not fully understood or on which substantiating data are lacking. These are being reviewed by the Committee, and a program of research work will be undertaken later to obtain data which will enable the cupola operator to manipulate his furnace along the most technically controlled lines.

Steeering Committee Formed

Last year the Cupola Research Committee approved formation of a Steering Committee to direct its work, with the following personnel:

Chairman, Donald J. Reese, International Nickel Co., New York.

S. C. Massari, Association of Manufacturers of Chilled Car Wheels, Chicago.

R. G. McElwee, Vanadium Corporation of America, Detroit.

Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va.

John L. Lowe, Battelle Memorial Institute, Columbus, Ohio.

Financing the Project

A budget of $100,000 has been approved by the general committee, based on a five year project. Items included in this budget are shown below:

Literature review and preparation of sub-committee reports prior to publication	$ 9,500
Publication of Handbook	20,000
Research investigation in operating foundries	60,000
Research in schools, institutions, commercial laboratories, etc.	10,500
TOTAL	$100,000

Contributor Firms

An excellent beginning has been made in financing the project, some 100 companies having already contributed. Other firms throughout the industry are being invited to participate by the Finance Committee, headed by Max Kuniansky. Contributors to date (June 8, 1942) are as follows:

Cupola Research Project
1941-42 Pledges and Payments

Acme Foundry Co., Eureka, Calif.
Alabama Clay Products Co., Birmingham.
Almont Manufacturing Co., Imlay City, Mich.
American Cast Iron Pipe Co., Birmingham.
American Chain & Cable Co., Bridgeport, Conn.
American Hardware Corp., New Britain, Conn.
American Hoist & Derrick Co., St. Paul, Minn.
Anderson Foundry Co., Bayport, Minn.
Ann Arbor Foundry Co., Ann Arbor, Mich.
B. B. Foundry Ltd., Berkeley, Calif.
T. H. Benners & Co., Birmingham.
Brown Fayro Co., Johnstown, Pa.
Buick Motor Div., General Motors Corp., Flint, Mich.
Cadillac Motor Car Div., General Motors Corp., Detroit.
Campbell Wyant & Cannon Fdy. Co., Muskegon, Mich.
Chamberlain Co., Oakland, Calif.
Chicago Foundry Co., Chicago.
Chicago Retort & Firebrick Co., Chicago.
Climax Molybdenum Corp., New York.
Jas. B. Clow & Sons, Chicago.
Continental Gin Co., Birmingham.
Crouse-Hinds Co., Syracuse, N. Y.
Crown Iron Works, Minneapolis.
Darbyshire Harvie Iron & Mach. Co., El Paso, Texas.
Delco Remy Div., General Motors Corp., Anderson, Ind.
Del Monte Properties Co., Del Monte, Calif.
Eastern Clay Products Co., Detroit.
Eaton Mfg. Co., Foundry Div., Detroit.
Electro Metallurgical Co., New York.
Elkhart Foundry & Machine Co., Elkhart, Ind.
Fairmont Ry. Motors Co., Fairmont, Minn.
Federal Foundry Supply Co., Detroit.
Frank Foundries Corp., Moline, Ill.
Frick Co., Waynesboro, Pa.
General Foundry & Mfg. Co., Flint, Mich.
Gibson & Kirk Co., Baltimore, Md.
Glamorgan Pipe & Foundry Co., Lynchburg, Va.
Globe Iron Co., Jackson, Ohio.
Goulds Pumps, Inc., Seneca Falls, N. Y.
A. P. Green Fire Brick Co., Mexico, Mo.
Harbison Walker Refractories Co., Pittsburgh.
Hart-Carter Co., Minneapolis.
Hill & Griffith Co., Cincinnati.
Indiana Gas & Chemical Corp., Terre Haute, Ind.
Industrial Equipment Co., Minster, Ohio.
International Nickel Co., New York.
Ironton Fire Brick Co., Ironton, Ohio.
Jackson Iron & Steel Co., Jackson, Ohio.
Jamestown Iron Works, Inc., Jamestown, N. Y.
Jamestown Malleable Iron Corp., Jamestown, N. Y.
Jeffrey Quest Foundry Co., Minneapolis.
Kohler Co., Kohler, Wis.
Koppers Co., American Hammered Piston Ring Div., Baltimore, Md.
Koppers Co., Minnesota Div., St. Paul.
LaGrange Iron Works, LaGrange, Ga.
Leeds & Northrup Co., Philadelphia.
Link Belt Co., Chicago.
Lynchburg Foundry Co., Lynchburg, Va.
Manufacturers Foundry Co., Waterbury, Conn.
Mathiesen Alkali Co., New York.
McWane Cast Iron Pipe Co., Birmingham.
Minneapolis-Moline Power Implement Co., Minneapolis.
Modern Equipment Co., Port Washington, Wis.
National Engineering Co., Chicago.
New Jersey Silica Sand Co., Millville, N. J.
Phoenix Iron Works, Oakland, Calif.
Plainville Casting Co., Plainville, Conn.
Pontiac Motor Div., General Motors Corp., Pontiac, Mich.
Rincon Foundry Co., San Francisco, Calif.
Roots Connersville Blower Co., Connersville, Ind.
Sacks Barlow Foundries, Inc., Newark, N. J.
Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich.
J. D. Sample, Birmingham.
Sibley Machine & Foundry Corp., South Bend, Ind.
A. P. Smith Mfg. Corp., East Orange, N. J.
Snow & Galgiani, San Francisco, Calif.
Spencer Turbine Co., Hartford, Conn.
Standard Foundry Co., Worcester, Mass.
Steacy Schmidt Mfg. Co., York, Pa.
F. B. Stevens, Inc., Detroit.
Stockham Pipe Fittings Co., Birmingham.
St. Paul Foundry Co., St. Paul.
Stuart Foundry Co., Detroit.
Taylor & Flinn Co., Hartford, Conn.
Thomas Foundries, Inc., Birmingham.
Union Foundry Co., Fitchburg, Mass.
University of Minnesota (Student Chapter), Minneapolis.
Vanadium Corp. of America, New York.
Walker Machine & Foundry Corp., Roanoke, Va.
Walker Metal Products Co., Windsor, Ont., Canada.
Warren Pipe Co., Everett, Mass.
Washburn Shops, Worcester, Mass.
Waterbury Farrel Foundry and Machine Co., Waterbury, Conn.
Western Foundry Co., Chicago.
Whiting Corp., Harvey, Ill.
Wilcox Crittenden & Co., Middleton, Conn.
Wolverine Foundry Supply Co., Detroit.
Worcester Foundry Co., Worcester, Mass.
Yale & Towne Mfg. Co., Stamford, Conn.

Book Review

"*MODERN Core Practices and Theories,*" by Harry W. Dietert, Harry W. Dietert & Co., Detroit, published by American Foundrymen's Association, Chicago; cloth bound; containing 532 pages; $5.00 to members of the American Foundrymen's Association, $8.00 to non-members.

So far as is known, this is the first book ever published devoted exclusively to the materials and equipment used for the production of cores. The author is internationally recognized for his work on sands and their uses in the foundry, and the new book is a compilation, considerably extended, of material presented by him at a series of lectures at the 1941 and 1942 conventions of A.F.A.

The book is divided into over 20 chapters dealing with such subjects as sands used in foundry cores, their proper selection, and types available in many districts. Discussion of core binding materials occupies an important place in the volume, dealing with three classes of binders, including oil, cereal, and clay binders of different types. Of paramount interest is the section devoted to core mixtures for steel, gray iron, malleable, brass, bronze, aluminum, copper and magnesium castings. Storage, conditioning and handling of core materials is discussed thoroughly, as is the proper mixing technique, as well as mixing equipment.

A considerable portion of the

book is devoted to coremaking methods and equipment. Core baking and core ovens are discussed fully, including how various type binders used in cores act under heat. Effect of many additional variables such as rate of moisture elimination, atmospheric humidity, arrangement of cores in the oven and fineness of sand are included. Oven control methods and fuels are discussed. Chapters in the new book are devoted to finishing, handling, testing, setting of cores and core coatings. Sand reclamation and core shakeout are discussed extensively.

Hamilton Foundry Gets "Minute Man" Flag for War Bond Buying

THE foundry industry is more than doing its share in the war program, not only in producing war materials but also in purchasing war bonds so as to help the Government purchase those materials. Typifying this spirit is the Hamilton Foundry & Machine Co., Hamilton, Ohio, who recently received the coveted blue "Minute Man" flag of the U. S. Treasury department. The flag is awarded when at least 90 per cent of a firm's employees participate in the payroll allotment plan of purchasing war bonds.

Actually, 92 per cent of the Hamilton employees are now participating in this plan. Employees invest an average of $3.23 a week, and 6.3 per cent of the company's entire payroll is used to buy war bonds.

The flag was presented to the Hamilton company May 29 at a meeting staged in the plant assembly room for employees and their families. President P. E. Rentschler accepted the award, which was presented by Walter S. Rowe, chairman of the local war bond pledge campaign. Subsequently Mr. Rentschler gave some highlights of the firm's war production, stating that the company now is engaged 100 per cent in war work, and that during May shipments exceeded the previous month's record for the sixth consecutive month. He also stated that the plant worked at full capacity on Decoration Day, with less than 1.5 per cent absentees and that 28 former employees now are in active military service.

Active in Red Cross Work

In addition to its war work, the Hamilton company has been extremely active in Red Cross training and plant protection work. Employee identification procedure was instituted several years ago, and a carefully planned system of plant guarding and protection against possibilities of sabotage has since been installed.

At the May 29th meeting thirteen employees were awarded certificates for having completed the official Red Cross first aid

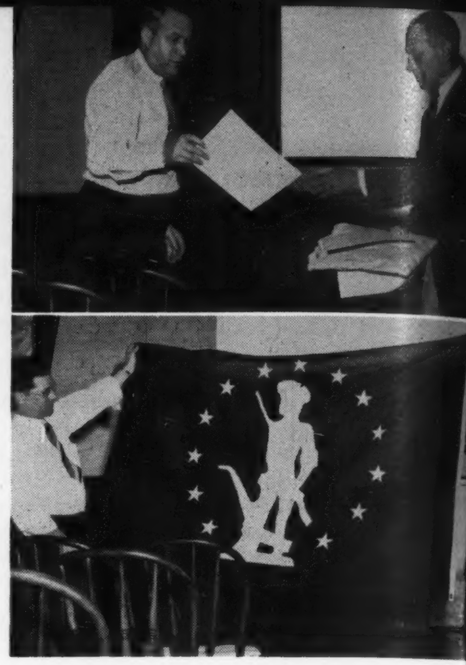


Fig. 4—(Top) President Rentschler receives from Walter S. Rowe, chairman of the local bond pledge campaign, "Honor Certificate" for having 90 per cent employee participation in voluntary payroll deduction plan for purchase of war bonds. (Bottom) Eldon Altman, personnel director, received the "Minute Man" flag which accompanied the Honor Certificate.

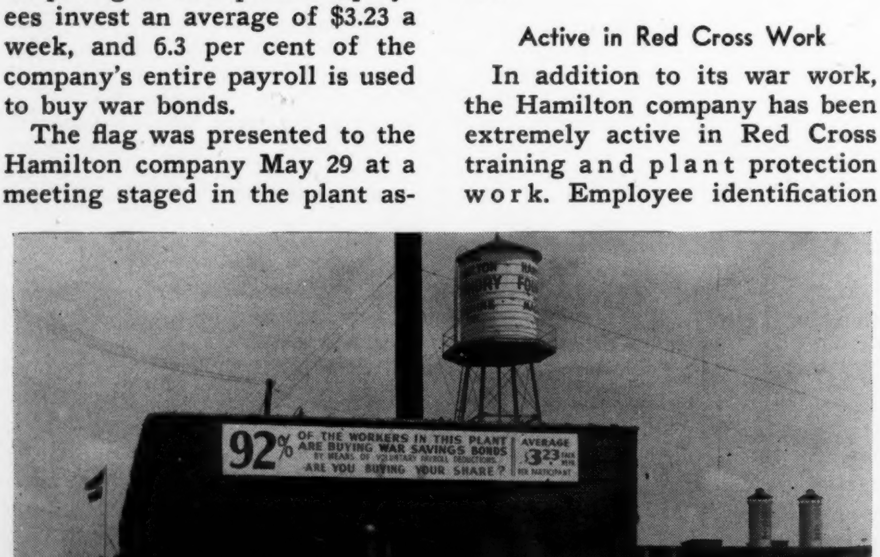


Fig. 1—Entrance to Hamilton Foundry & Machine Co., Hamilton, Ohio, with placard announcing 92 per cent employee participation in purchase of war bonds. For this the company received the Treasury Department's "Minute Man" flag, seen in left rear, flying below the national colors.

Fig. 3—Honor Roll of the Hamilton Foundry & Machine Co. shows 28 employees now are on active duty with U. S. military forces.

Fig. 2—(Left) Part of the original class of Hamilton employees enrolled in the standard Red Cross training course, demonstrating the giving of artificial respiration. These classes are held ten consecutive Thursday evenings, two hours per evening. Instructor Floyd B. Chapman is standing in the rear. (Top Right) Employees demonstrate first aid to injured, placing the "victim" on a stretcher after applying a traction splint. (Bottom Right) P. E. Rentschler, at left, president of the Hamilton company, presenting Floyd B. Chapman with a $25 war bond in appreciation for his work as instructor in first aid training.

training course. A considerable number of employees are constantly taking the training course, under direction of Floyd B. Chapman, instructor.

Mr. Chapman, a molder at the Standard Castings Co., Cincinnati, commutes to Hamilton each day five nights a week to give the course.

During the meeting, President Rentschler presented him with a $25.00 War Savings Bond in appreciation of his work.

Graduates of the course gave a fifteen minute demonstration in first aid at the meeting. The evening ended with presentation of motion pictures, including an official British film on civilian defense, the American League baseball film on the life of Lou Gehrig, and a sound film "MacArthur and the Bombing of Manila."

Foundries Urged to Adopt Payroll Savings Plan for War Bond Buying

TO FURTHER the nationwide program for purchase of War Savings Bonds on the voluntary Payroll Savings Plan, the American Foundrymen's Association has been asked by the U. S. Treasury Department to cooperate in spreading the plan throughout the foundry industry. The goal set by the Government is to divert at least 10 per cent of the national income into war bonds.

A.F.A. urges every foundry member of the Association that has not already done so, to install a Payroll War Savings Plan at the earliest possible date. The plan is a convenient and systematic method by which all workers may save regularly through payroll deductions for the purchase of war bonds.

It involves a relatively simple bookkeeping arrangement under which employees authorize their employers to withhold a definite sum from each pay envelope or check, to be accumulated in a trust fund. When a worker has thus saved enough for the purchase of a war bond, the bond is delivered to him.

Why Ten Per Cent?

It is estimated that the national income today is 12 billion dollars. Due to our tremendous production of war materials, consumer goods are getting scarcer every day, in spite of price ceilings. It is feared that growing demand brings with it the danger of inflation. Thus the diversion of 10 per cent of America's payroll is felt necessary to:

1. Further systematic savings to provide a "brake" on inflation.
2. Provide a backlog of purchasing power to stimulate private business and employment after the war.
3. Help provide the guns, tanks, planes and ships vital for Victory.

Labor Has Approved

One important outgrowth of the campaign is an improvement in employer-labor relations, through mutual cooperation in a common purpose. Major labor organizations have endorsed the program whole-heartedly and approved the plan wherever their cooperation has been sought. There are many instances of employee groups requesting management to install the plan.

Information on Procedure

Detailed information can be obtained from local war savings committees, or direct from the War Savings Staff of the U. S. Treasury Department, Washington, D. C.

"A DIME FROM EVERY DOLLAR EVERY PAY DAY"

New and Revised Definitions of Foundry Sand Terms Are Approved

NEW definitions of terms applying to the properties of foundry sands, and revised definitions of terms previously used, were recently approved by the Executive Committee of the A.F.A. Foundry Sand Research Committee. The work of clarifying present definitions, and of adding to them in view of the newer investigations on the effect of high temperatures on sand properties, has been going on for several years under the Sub-Committee on Nomenclature of the Sand Research Committee.

Serving on the sub-committee were the late Prof. A. C. Davis, Cornell University, as Chairman; H. W. Dietert, Harry W. Dietert Co., Detroit, and John Grennan, University of Michigan, Ann Arbor, Mich. It is requested that authors of sand papers use the newly approved terminology so as to avoid confusion in literature.

New terms approved by the committee, with respective definitions, are as follows:

Collapsibility

The ability of a sand mixture to break down under the conditions of temperature, atmosphere and pressure existing during solidification and cooling.

Toughness

The ability of a sand mixture to absorb energy.

Unit Toughness (Toughness Number)

The energy absorbed by a unit volume of a sand mixture before fracture occurs.

Yield Strength

The stress at which a sand mixture shows a specified permanent deformation.

Hardness

The resistance offered by a sand mixture to small area deformation.

Hot Strength

The strength developed by a sand mixture at any temperature above 230 degs. Fahr. (110 degs. Cent.)

Hot Deformation

The deformation which accompanies the hot strength.

Thermal Expansion

The increase in volume of a sand mixture accompanying a change of temperature.

Thermal Contraction

The decrease in volume of a sand mixture accompanying a change of temperature.

Retained Strength

The strength developed by a sand mixture after it has been heated to a temperature above 230 degs. Fahr. and then cooled to room temperature.

Fire Clay

A clay having a fusion point of cone 19 (2768 degs. Fahr.—1520 degs. Cent.) or higher. (Refer to refractory clay.)

Terms previously defined, with their revised definitions as approved by the committee, are:

Compressive Strength

Old Definition—The maximum resistance which a molded sand offers to a compressive stress.

New Definition—The maximum compressive stress which a sand mixture is capable of developing.

Tensile Strength

Old Definition—The maximum resistance which a molded sand offers to a force which tends to pull it apart.

New Definition—The maximum tensile stress which a sand mixture is capable of developing.

Shear Strength

Old Definition—The maximum resistance which a molded sand offers to a shearing stress.

New Definition—The maximum shear stress which a sand mixture is capable of developing.

Transverse Strength

Old Definition—The maximum resistance which a molded sand offers to a transverse stress.

New Definition—The old definition is in error because there is no such thing as the transverse strength of a sand mixture. Failure in transverse loading is caused by either shear or tension. The transverse strength of a specimen is determined by the tensile strength of the mixture, the dimensions of the specimen and the method of loading.

Dry Strength, Dry Bond Strength

Old Definition—The maximum resistance which a molded sand, dried at 221 to 230 degs. Fahr. (105 to 110 degs. Cent.) offers to an applied stress before it breaks.

New Definition—The maximum resistance which a molded sand, dried at 221 to 230 degs. Fahr. (105 to 110 degs. Cent.), offers to deformation.

Green Strength, Green Bond Strength

Old Definition—The resistance which a molded sand, while tempered, offers to an applied stress before it breaks.

New Definition—The maximum resistance

which a molded sand, while tempered, offers to deformation.

Refractory Clay

Old Definition—One which does not fuse below 3000 degs. Fahr. (1650 degs. Cent.)

New Definition—One which fuses at cone 25 (2894 degs. Fahr.—1590 degs. Cent.)

Facing

Old Definition—Any material applied in a wet or dry condition to the face of a mold for the purpose of improving refractory value or to reduce penetration.

New Definition—A coating of any material applied in a wet or dry condition to the face of a mold or core.

Mold or Core Wash

(See Facing)

Facing Sand

Old Definition—Any special sand mixture placed against the pattern for improving the surface of the casting, or giving certain desired properties to the face of the mold.

New Definition—Any special sand mixture placed against the pattern to give certain desired properties to the face of the mold.

Fines

Old Definition—This term is used to designate those particles of the sand which are retained on the 200, 270 sieves and pan, as determined by the A.F.A. fineness test.

New Definition—A term the meaning of which varies with the type of foundry or the type of work. It refers to those sand grain sizes substantially smaller than the predominating grain size.

Optimum Moisture

Old Definition—The content of the sand which produces the maximum degree of the property or properties desired in the sand.

New Definition—That moisture content which results in the maximum development of any property of a sand mixture.

It has been suggested that a definition be formulated for "Workable Moisture" and the meaning of "Temper" be clarified. In view of the fact that these terms are frequently used in such a way as to imply the same thing, and in view of the fact that "Temper" is used to mean several different things, the Sub-committee on Nomenclature hesitates to formulate definitions for these terms. Members are invited to try their hands at suggested definitions for these terms.

An Abstract of A.S.T.M. Standard Specifications for Carbon-Steel Castings

STANDARD *Specifications for Carbon-Steel Castings for Miscellaneous Industrial Uses* bears the A.S.T.M. designation A27-39. These specifications cover carbon-steel castings to be used for miscellaneous industrial purposes, as distinguished from carbon-steel castings made for railroad and high-temperature applications. Ten grades are covered, the grade desired to be specified by the purchaser.

Grade N-1 not required to be physically tested, nor to be heat treated in any manner except as conditionally provided for.

Grade N-2 not required to be physically tested, but required to be annealed.

Grade A-1 required to be physically tested, but not required to be heat treated except as conditionally provided for.

Grade A-2 required to be annealed and to be physically tested.

Grade A-3 required to be full annealed and to be physically tested.

Grade B required to be annealed and to be physically tested.

Grade B-1 required to be full annealed and to be physically tested.

Grade B-2 required to be full annealed and to be physically tested.

Grade H required to be annealed and to be physically tested.

Grade H-1 required to be full annealed and to be physically tested.

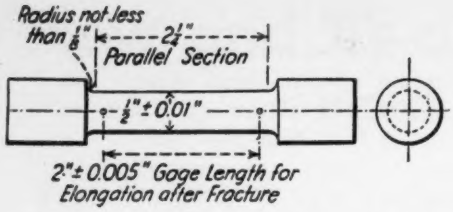
Heat Treatment

A heat treatment either by normalizing or by full annealing, at the option of the manufacturer, shall be applied to all castings of grades N-2, A-2 B and H; also to all castings of grades N-1 and A-1 when their carbon content exceeds 0.30 per cent. A full annealing treatment shall be applied to all castings of grades A-3, B-1, B-2, and H-1. When mutually agreed upon by the manufacturer and the purchaser, castings specifically designated in any grade except grades A-1, A-3, B-1, B-2 and H-1 may be given a supplementary heat treatment that includes accelerated cooling by liquid quenching, liquid spraying or air blasting. The procedure for normalizing, full annealing, tempering or drawing, and cooling are explained in detail. In the explanatory notes of the specification, the terms heat treatment, accelerated cooling by liquid contact and proper holding or "soaking" are explained. Concerning cooling, usually the absence or degree of hazard resulting from cooling by liquid contact is estimated somewhat in proportion to the similarity or extent, or both, of member-thickness.

The steel shall conform to the following requirements as to chemical composition:

Manganese, max., per cent......1.00
Phosphorus, max., per cent....0.05
Sulphur, max., per cent...........0.06

An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, silicon, phosphorus, and sulphur. This analysis shall be made from the drillings taken not less than ¼-in. beneath the surface of a



NOTE.—The gage length, parallel section, and fillets shall be as shown, but the ends may be of any shape to fit the holders of the testing machine in such a way that the load shall be axial.

Fig. 1—Dimensions of test specimens used in determining tensile strength.

test ingot made during the pouring of the melt.

Mechanical Properties

The tensile properties of steel for castings of the grades that require physical testing shall be determined from the required number of specimens having a 2-in. gage length, conforming to the dimensions shown in Fig. 1.

Steel used for the castings shall conform to the requirements as to tensile properties prescribed in Table 1.

TABLE I.—TENSILE REQUIREMENTS.

	Tensile Strength, min., psi.	Yield Point, min., psi.	Elongation in 2 in., min., per cent	Reduction of Area, min., per cent
Grade A-1, Unannealed....	60 000	30 000	22	30
Grade A-2, Normalized[a]...	60 000	30 000	26	38
Grade A-3, Full annealed..	60 000	30 000	24	35
Grade B, Normalized[a].....	70 000	38 000	24	36
Grade B-1, Full annealed..	66 000	33 000	22	33
Grade B-2, Full annealed..	70 000	35 000	20	30
Grade H, Normalized[a].....	80 000	43 000	17	25
Grade H-1, Full annealed.	80 000	40 000	17	25

[a] Any casting that may be ordered to meet the tensile requirements above listed for normalized material of grades A-2, B, and H may, at the option of the manufacturer, be given a full-annealing treatment instead of a normalizing treatment; provided that the above listed tensile requirements for normalized material are met.

One or more test coupons sufficient in size and number to provide the required test specimens shall be cast separately or attached to one or more castings of the kind ordered by the purchaser, in each melt used for manufacture of the purchased material. In the explanatory notes of the specification it is said that the direct attachment of test coupons for their entire length and width to commercial castings of certain designs is inadvisable, even when the castings are sufficiently large to permit such attachment. A test coupon may be so formed and attached as to "bleed" the connected casting, thereby forming a solid coupon while injuring a member which may function largely as a feeding head for the coupon. The special test block conventionally used in many steel foundries, frequently called a "keel-block," consists of a slab or plate having a small area and one or more underlying ribs. Such physical test coupons as may have been connected directly or by runners to commercial castings shall remain so attached until the material is submitted for inspection. All physical test coupons shall be heat treated with the castings represented by them unless the purchaser authorizes separate heat treatment.

One tension test shall be made from each melt in each heat treatment charge. Another specimen may be substituted from the same lot if any specimen shows defective machining or develops flaws. If the percentage of elongation of any tension test specimen is less than specified in Table 1 and any part of the fracture is more than ¾-in. from the center of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed. After the acceptance (for one or more) of 15 consecutive melts containing castings subject to physical tests, the manufacturer may assemble the castings from succeeding melts in groups of five melts each, not exceeding 40 tons in weight per group. The castings in each group shall be accepted if the chemical analyses and the test specimens representing the group fulfill the chemical and physical requirements of these specifications.

The requirements for workmanship, finish and inspection are much the same as those for other A.S.T.M. specifications. However, it is interesting to note that defects in the finished product that will not ultimately impair the strength of the castings may, with the consent of the purchaser's inspector, be welded by an approved process.

Full details of this specification have been issued under the title *"Standard Specifications for Carbon-Steel Castings for Miscellaneous Industrial Uses,"* A.S.T.M. Designation A27-39, and may be obtained either from the offices of your Association, 222 W. Adams St., Chicago, or from the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., for a nominal fee.

Committee Service Opportunities

Appointments to the various technical committees of A.F.A. now are being made for the coming year, by President D. P. Forbes. Association members who desire to be considered for committee service should write the Secretary of A.F.A. promptly, 222 W. Adams St., Chicago, Ill., stating preference as to field of activities.

Committee service is a privilege, a training field, and an opportunity for broadening acquaintanceship not available through any other medium. Those who have served and are serving state emphatically that committee work makes possible more rapid advancement in the profession, and makes many new and lasting friends.

Opportunities for committee service are available in the Gray Iron, Steel, Malleable Iron, Non-Ferrous, and Patternmaking divisions of A.F.A. Committees of general interest are as follows: (1) Foundry Costs, (2) Apprentice Training, (3) Foreman Training, (4) Plant and Plant Equipment, (5) Job Evaluation and Time Study, (6) Foundry Refractories, (7) Sand Research, (8) Program and Papers, and (9) Engineering School Cooperation.

Registration Lists of 1942 Convention Ready

COMPLETE lists of registered attendance at the 1942 A.F.A. Convention and Exhibit, held in Cleveland April 20-24, have now been printed and are available for distribution. Company connections of all who registered are listed alphabetically, and the names occupy 81 pages,

prepared in handy 5½x8½ inch size.

The record attendance of the 1942 convention, plus the rapid changes in executive and supervisory personnel made during the past year, make this year's registration list especially valuable for purposes of reference.

It was particularly noticeable at the Cleveland meeting that a great many plants sent more of their key men than usual, if only for a day or two each. For example, one large company registered 28 men, from foremen to works manager, from just one of its several plants.

The 1942 Registration Lists are available to the industry as follows: 5 copies free *on request* to 1942 exhibitors, additional copies $1.00 each; to non-exhibitors, $5.00 per copy.

New Members

"Alabama casts eleven votes" this month for leadership in new members recorded. Birmingham Chapter thus leads the parade for the period May 16 to June 15, with eleven new members. Chicago Chapter runs second with five, and fifteen chapters in all reported additions to their rosters. What about the other seven A.F.A. chapters? Next month we expect to have a long list of new members, with every chapter "present and accounted for." Attention, Chapter Membership Chairmen! New members—Forward March!

(May 16 to June 15, 1942)

Birmingham Chapter

J. F. Carle, Pres., Southern Testing Laboratories, Inc., Birmingham, Ala.
J. L. Corley, Patternmaker, Stockham Pipe Fittings Co., Birmingham, Ala.
B. Cecil Head, Cleaning Foreman, American Cast Iron Pipe Co., Birmingham, Ala.
M. J. Henley, American Cast Iron Pipe Co., Birmingham, Ala.
James C. King, Loading Yard Foreman, American Cast Iron Pipe Co., Birmingham, Ala.
C. O. Ledbetter, Casting Foreman, American Cast Iron Pipe Co., Birmingham, Ala.
E. D. McCauley, American Cast Iron Pipe Co., Birmingham, Ala.
M. A. Nelson, American Cast Iron Pipe Co., Birmingham, Ala.
B. Lloyd Parsons, Foreman Mall. Fdry., Stockham Pipe Fittings Co., Birmingham, Ala.
S. E. Phelps, American Cast Iron Pipe Co., Birmingham, Ala.
George S. Williamson, Cleaning Shed Foreman, American Cast Iron Pipe Co., Birmingham, Ala.

Central Indiana Chapter

H. J. Druecker, Vice-Pres. & Gen. Mgr., Indiana Products Co., Kokomo, Ind.
Charles E. Fatout, National Malleable & Steel Castings Co., Indianapolis, Ind.

Chesapeake Chapter

Arville B. Cross, U. S. Naval Gun Factory, Washington, D. C.

Chicago Chapter

William H. Koehler, Draftsman, National Engineering Co., Chicago, Ill.
Walter Schulte, Draftsman, National Engineering Co., Chicago, Ill.
Edward J. Subko, Core Room Foreman, Burnside Steel Foundry, Chicago, Ill.
Carl Swanson, Draftsman, National Engineering Co., Chicago, Ill.
***Velsicol Corporation, Chicago, Ill. (N. L. Mooneyham, Sales Representative)**

Cincinnati Chapter

W. J. Buvinger, Works Mgr., Buckeye Foundry Co., Cincinnati, Ohio
O. Jay Myers, Jr. Met., Wright Aeronautical Corp., Lockport, Ohio

Detroit Chapter

Gunnard A. Eliason, Casting Engr., Chrysler Corp., Highland Park, Mich.
Columbus Floyd, Instructor in Metallurgy, University of Detroit, Detroit, Mich.
Robert J. Gibbons, Gen'l Foreman of Fdry., Aluminum Co. of America, Detroit, Mich.

Northern California Chapter

C. A. Christenson, Lathan Company, South San Francisco, Calif.

Ontario Chapter

***General Smelting Company of Canada, Ltd., Hamilton, Ont. (George Pitt, Supt.)**
Ernest E. Maynard, Instructor, Western Technical Commercial School, Toronto, Ont.

Philadelphia Chapter

***F. N. Miller Foundry, Philadelphia, Pa. (F. N. Miller, Owner.)**
E. G. Stratton, Salesman, Geo. F. Pettinos, Inc., Philadelphia, Pa.

St. Louis, Chapter

John Brodak, Walworth Company, St. Louis, Mo.
E. A. Williams, Works Mgr., National Bearing Metals Corp., St. Louis, Mo.

Southern California Chapter

Vernon Hansen, General Metals Corp., Los Angeles, California.

Toledo Chapter

J. H. Bridge, Pres. & Mgr., The Maumee Pattern & Mfg. Co., Toledo, Ohio.

Twin City Chapter

Roy E. Gorgen, Owner, Roy E. Gorgen Co., Minneapolis, Minn.
Paul Kordiak, Shop Foreman, Scott-Atwater Manufacturing Co., Minneapolis, Minn.

Western New York Chapter

Robert H. Baker, Asst. Supv. Fdry., General Railway Signal Co., Rochester, N. Y.

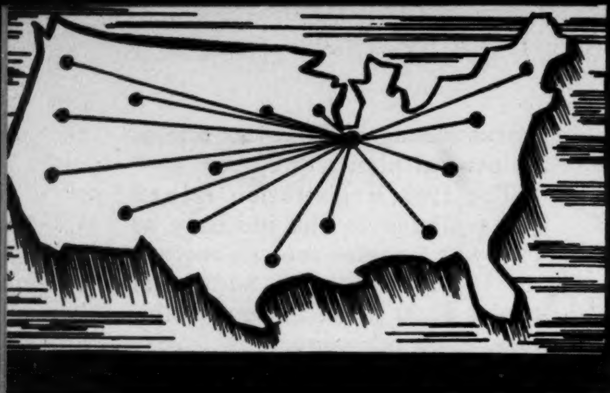
Wisconsin Chapter

Fred N. Troupe, Supv. of Core Room, Ampco Metal, Inc., Milwaukee, Wis.

Outside of Chapter

Mr. Bull, Gen. Mgr. Fdry., Dartmouth Auto Casting Co., Ltd., Smethwick Staffs, England.
Norbert K. Daerr, Fort Pitt Steel Casting Co., McKeesport, Pa.
Robert E. Daly, American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
***Homestead Valve Mfg. Co., Coraopolis, Pa. (F. E. Schuchman, Gen. Mgr.)**
***Penola, Inc., Pittsburgh, Pa. (W. S. Davis, Jr., Vice-Pres.)**
Vytaut Sabulis, Hunt Spiller Mfg. Corp., Boston, Mass.
R. Shotton, Gen. Mgr., Shotton Bros Iron Founders, Oldbury Staffs, England.
H. L. Sterling, Talleres y Fundicion Mecanica Catia, Caracas, Venezuela.
W. Warmington, Sales Director, Pneulec Ltd., Smethwick Staffs, England.

*Company Member.



Chapter Activitie

Ontario Chapter Joins Other Groups in Metals Conservation

By G. L. White*, Toronto, Ontario.

AN IMPORTANT meeting on non-ferrous metals conservation was held May 27 in the physics building, University of Toronto, Toronto, under auspices of the Affiliated Engineering and Allied Societies in Ontario. The group is composed of thirteen engineering organizations, including the Ontario Chapter of A.F.A.

Four speakers addressed the meeting, and indicated that important savings in tin could be effected without impairing the quality of product. K. H. J. Clarke, office of the Metals Controller, Department of Munitions and Supply, Ottawa, discussed "The Metal Situation." Mr. Clarke stressed the vital need for tin conservation, and three following speakers indicated how important savings may be realized in bronzes, solders and babbit metals.

Other speakers and their subjects were: G. E. Tait, Dominion Engineering Co., Ltd., Montreal, "Alternate Bronzes"; J. S. Fullerton, Handy & Harman, Toronto, "Alternate Bronzes"; I. I. Sylvester, Canadian National Railways, Montreal, "Alternate Babbits."

It was brought out that alternate materials are available with properties equal or superior to those of the traditional alloys for many applications, although for certain purposes it still is difficult to suggest adequate substitutes. Principal problems today are in the selection of the proper alternate material for a given purpose, and the adaptation of manufacturing practice to its successful use.

Ontario Non-Ferrous Committee

Participation of the Ontario Chapter of A.F.A. followed appointment, at a meeting held May 1 at Hamilton, of a special Non-Ferrous Committee of the chapter, to cooperate with the office of the Metals Controller in furthering Canada's war effort. J. Sully, Sully Brass Foundry, Ltd., Toronto, was appointed chairman of the special committee, and J. C. Stavert, Babcock-Wilcox & Goldie-Mc Culloch, Ltd., Galt, was made secretary. Other members of the committee are as follows:

H. W. Burgess, Wallaceburg Brass, Ltd., Wallaceburg; S. R. Francis, Metals & Alloys, Ltd., Toronto; H. V. Ivey, Empire Brass Co., Ltd., London; J. Langan, Canada Metal Co., Ltd., Toronto; R. McIntyre, Mueller, Ltd., Sarnia; A. H. Tallman, A. H. Tallman Bronze Co., Ltd., Hamilton, and J. Wagman, Z. Wagman & Son, Toronto.

*Westman Publications, Ltd., Toronto, Ont., and Secretary-Treasurer, Ontario Chapter, A.F.A.

1st Ladies' Night Held by Western New York

By Eliot Armstrong*, Buffalo, N. Y.

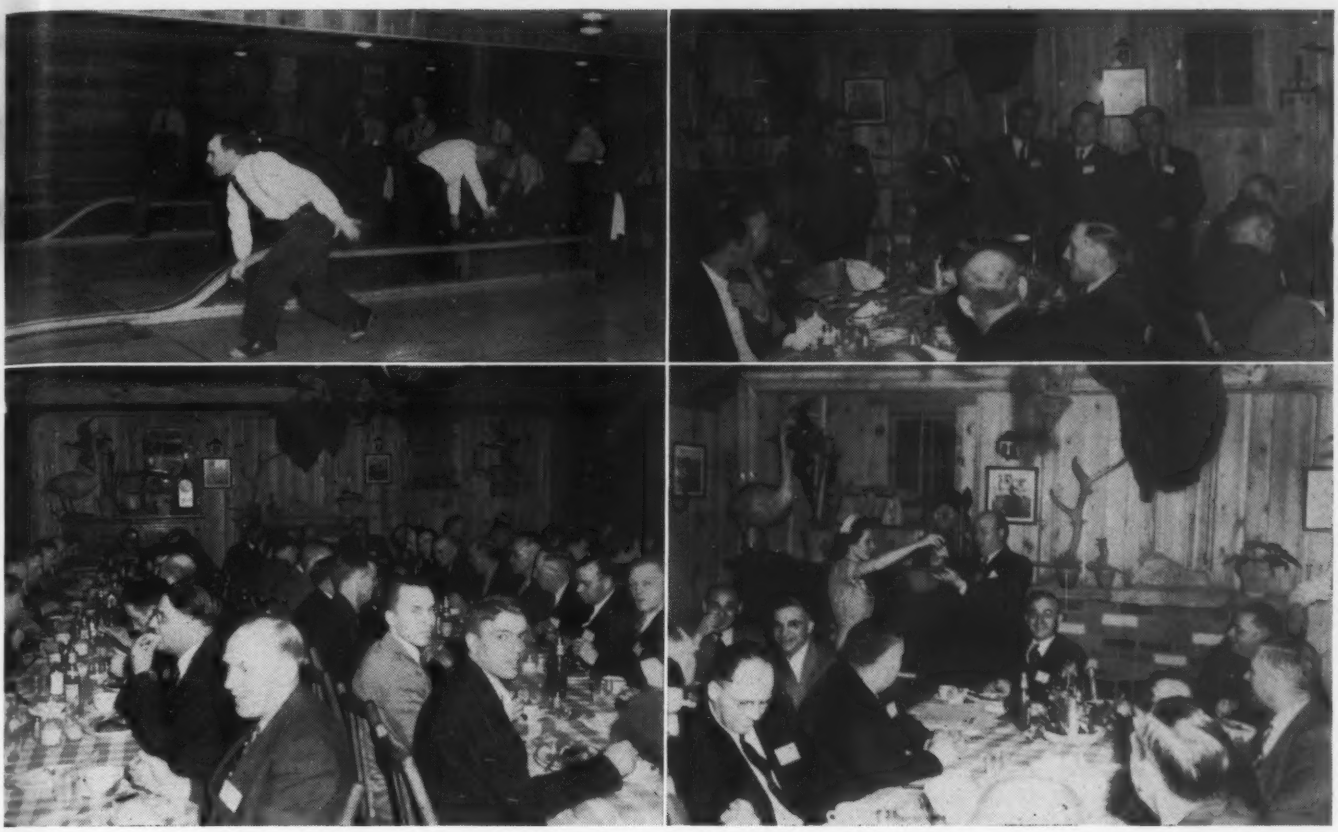
BOWING to the gentler sex, the Western New York Chapter held its first "Ladies' Night" dinner-dance May 23 at the Trap and Field Club, just outside Buffalo, N. Y. A splendid turn-out indicated complete approval of the innovation.

Chapter Chairman R. K. Glass, Republic Steel Corp., Buffalo, welcomed the ladies and guests with a very interesting and appropriate story of what the foundrymen contribute to the daily comforts and conveniences of American women in the way of household devices, heating and cooking utensils, piping, faucets and

*Inter-Allied Foundries of New York State, and Secretary, Western New York Chapter.

Photographs of the "Old Timers' Night" of the Northeastern Ohio Chapter in May tell the story of a grand evening. Local apprentices who participated in the apprenticeship contests, as well as the four local winners in the national A.F.A. contests, were the guests of the chapter.

(Photos courtesy S. N. Farmer, Sand Products Corp.)



(Photos courtesy O. W. Potter, University of Minnesota)

Covering the annual meeting of the Twin City Chapter at Long Lake, Minnesota. (Top Right)—Left to Right: chapter Vice-Chairman R. W. Bingham, American Hoist & Derrick Co., St. Paul; Chairman R. M. Aker; Student essay contest winners Harry Dahlberg (2d prize), Leo Brom (1st prize), S. S. Silberg (3d prize). (Bottom Right) Chairman Aker drawing for the door prizes supplied by the University of Minnesota Student Chapter of A.F.A.

tubs—many things that comprise the American way of living. He declared that the chapter had long confined its meetings to business topics but, encouraged by the success of other chapters, that they now hoped the ladies would insist on the men holding further ladies' night dinner-dances.

With one excellent orchestra playing for the dinner hour and another taking over at ten o'clock aided by special entertainment, the evening turned out to be one of grand fun and hilarity. At the end, the ladies voted they would indeed insist on continuation of these functions in the future, and everyone declared the first "Ladies' Night" of the chapter a pronounced success.

A major event of the evening was the commemoration of the fifth anniversary of the Western New York Chapter. In keeping with the occasion, R. K. Glass, the fifth chapter chairman, presented to T. H. Burke, the first chairman, the gavel used by Mr. Burke when he presided. The gavel contained a sterling silver plate on which the inscription was engraved: "T. H. Burke, Chairman 1937-1938, Buffalo Chapter, A.F.A."

Twin City Foundrymen Hold Annual Meeting

By O. W. Potter*, Minneapolis, Minn.

SOME eighty-six members and guests of the Twin City Chapter gathered at Kipp's Buckhorn Lodge, Long Lake, Minn., on May 25 for the annual meeting of the chapter. R. M. Aker, Western Alloyed Steel Casting Co., Minneapolis, presided as chapter Chairman, and announced the various committees for the coming year, the following to serve as chairmen:

Program Committee—R. W. Bingham, American Hoist & Derrick Co., St. Paul; *Membership*—R. C. Wood, Minneapolis Electric Steel Castings Co., Minneapolis; *Apprenticeship* — E. W. Eichhorn, American Brake Shoe & Foundry Co., Minneapolis; *Student Branch*—H. F. Scobie, University of Minnesota; *Non-Ferrous*—Fred Kaim, Union Brass & Metal Mfg. Co., St. Paul; *Gray Iron*—I. F. Cheney, Griffin Wheel Co., St. Paul; *Steel*—Chas. C. Hess, Western Alloyed Steel Casting Co., Minneapolis; *Pattern*—Joe Costello, American Hoist & Derrick Co., St. Paul; *Auditing*—E. C. Madson, Andersen Foundry Co., Bayport, Minn.

Following dinner, winners in the student essay contest were announced by H. F. Scobie as chairman of the Committee on Student Papers. The winning students, who were all present and gave short abstracts of their papers, are as follows: Leo J. T. Brom, 1st prize, "A Study of Minnesota Sandstones as Possible Foundry Materials"; H. R. Dahlberg, 2d prize, "Pearlitic

*University of Minnesota, and Secretary, Twin City Chapter of A.F.A.

Malleable Cast Iron and Its Possibilities"; S. S. Silberg, 3d prize, "A Torsion Impact Test for Cast Iron."

Judges of the essay contest were H. F. Scobie; Herb Blosjo, Minneapolis Electric Steel Castings Co., Minneapolis, and Axel Carlstrom, Smith-Sharpe Co., Minneapolis. Brief discussion followed the abstracting of the papers.

The meeting wound up with a bowling tournament in which all took part.

(Photo courtesy Howard M. Tomasko, University of Minnesota)

When the engineering college students of the University of Minnesota held their traditional, annual Engineers' Day celebration May 15th, one of the most interesting floats was that entered by the Student Chapter of A.F.A., with a smoking "cupola" and foundry atmosphere.

Detroit Chapter Gets New Honor and New Home

By A. H. Allen,* Detroit, Mich.

THE Detroit Chapter of A.F.A. has been accepted as an affiliate society of the Engineering Society of Detroit, housed in the new $2,000,000 Rackham Educational Memorial, 100 Farnsworth St., Detroit. Regular monthly meetings of the chapter now are being held in the beautiful new building, which offers sumptuous lounge and recreational facilities as well as banquet halls, meeting rooms and auditorium. Both the April and May meetings were held there, with attendance exceptionally large.

Eighteen local chapters of national technical organizations now are affiliated with the Engineering Society of Detroit and hold meetings in the new memorial building, which is fast becoming headquarters for all engineers in the Detroit area. The building, which also houses the extension division of the University of Michigan, was made possible through the generosity of Mrs. Mary A. Rackham and the Rackham Foundation, and is an impressive memorial to the late Horace H. Rackham, Detroit attorney and philanthropist.

Under leadership of the new chapter chairman, F. A. Melmoth, Detroit Steel Casting Co., the Detroit chapter already is drawing plans for a bigger and better series of monthly technical meetings, starting with the October meeting.

*Detroit editor, Penton Publishing Co., and Secretary, Detroit Chapter.

Twin City Students Select New Officers

By Sidney S. Silberg,* Minneapolis, Minnesota.

MEMBERS of the University of Minnesota Student Chapter of A.F.A. held their annual meeting May 21 at Coffman Memorial Union on the university campus, at which time officers for the forthcoming year were elected. Harry R. Dahlberg, second prize winner in the Twin City Chapter student essay contest, was elected president. Miles B. Olson was elected Secretary-Treasurer, taking over the duties of Sid Silberg, who now is an ensign in the Navy.

*Ensign, U. S. Navy, formerly Secretary, University of Minnesota Student Group of A.F.A.

Photo courtesy Glenn Coley, Detroit Edison Co.

The new $2,000,000 Rackham Educational Memorial in Detroit, new meeting headquarters of the Detroit Chapter since its acceptance as an affiliate society of the Engineering Society of Detroit.

Southern California Foundrymen Discuss Problems of Priorities

By E. M. Hagener*, Los Angeles, Calif.

THE largest turnout of members of the entire season attended the regular meeting of the Southern California Chapter, held May 18 at the Clark Hotel, Los Angeles. Many guests representing non-ferrous foundries were present, attracted by an up-to-the-minute program involving W.P.B. allocations and priorities. Chapter President B. G. Emmett, Los Angeles Steel Casting Co., Los Angeles, presided, and announced that Carleton Tibbetts, president, Los Angeles Chamber of Commerce, would present his address on "Winning the War" at a later date.

The main subject of the evening, "Allocation and Priorities as Related to the Foundry Industry," was presented by three members of the local War Production Board, Charles A. Taylor, Marcus B. Whitney, and James J. McDonald. A great deal of valued information was offered, ending with an informal question-and-answer session.

Frank Britt, Manual Arts High School, Los Angeles, another guest speaker, described a method of solving one phase of today's labor problem. He suggested that foundry executives, instead of turning away a foundry-minded applicant because of inexperience, should urge the applicant to use his spare time in learning the fundamentals of the trade in one of the free trade schools.

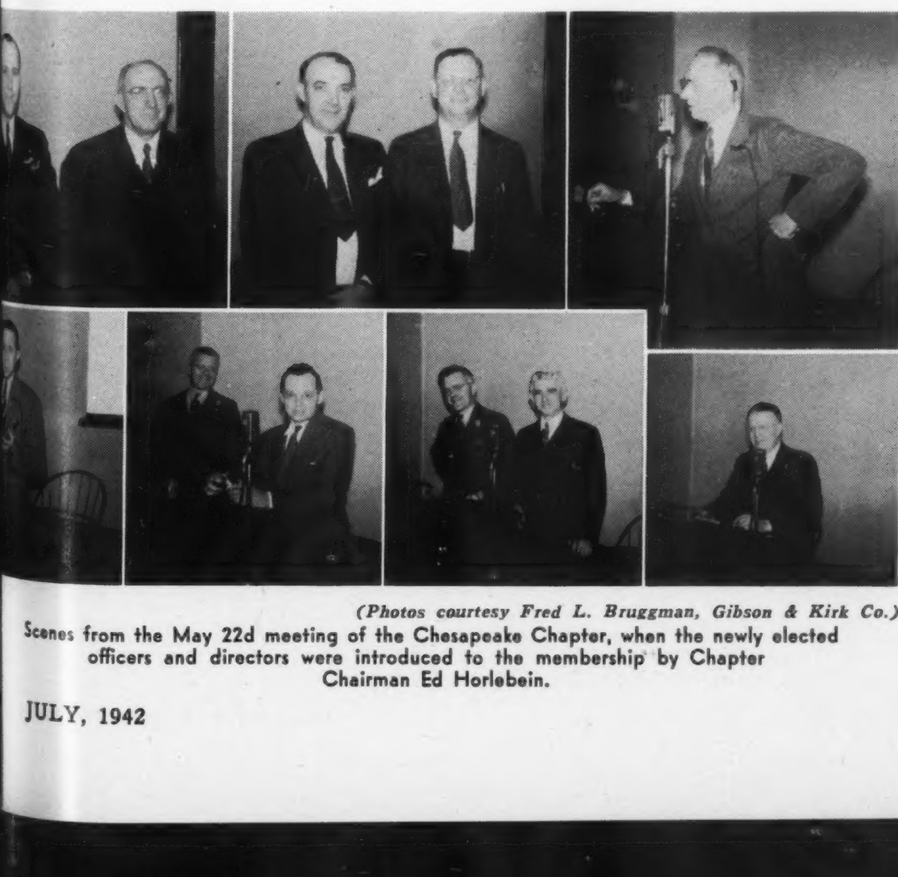
*General Metals Corp., and Secretary, Southern California Chapter.

New Officers and Directors

President Emmett announced that the slate of officers and directors for the coming year, as offered by the Nominating Committee, was unanimously accepted by the chapter membership, and plans were made for installation ceremonies. The new officers and directors are as follows:

Chairman — Earl Anderson, Enterprise Iron Works, Los Angeles; *Vice-Chairman* — Walter F. Haggman, Foundry Specialties Co., Huntington Park; *Secretary*—E. M. Hagener, General Metals Corp., Los Angeles; *Treasurer*—W. D. Bailey, Jr., Westlectric Castings, Inc., Los Angeles; *Directors*—(1 year) retiring President B. George Emmett; Fred Edmison, Mechanical Foundries, Inc., Los Angeles; Robert R. Haley, Advance Aluminum & Brass Co., Los Angeles; Delbert G. Luper, Grayson Heat Control, Ltd., Lynwood; Earl D. Shomaker, Kay-Brunner Steel Products, Inc., Alhambra; (2 years) J. Donald Locke, Long Beach Iron Works, Long Beach; Charles R. McGraw, Long Beach Brass Foundry, Long Beach; Dominic Meaglia, American Foundry Co., Montebello; A. H. Popperwell, Reliable Iron Foundry, Los Angeles.

Following the presentation of officers, an interesting technicolor picture "Cupola Charging" was shown through courtesy of Modern Equipment Co., Port Washington, Wis.



(Photos courtesy Fred L. Bruggman, Gibson & Kirk Co.)

Scenes from the May 22d meeting of the Chesapeake Chapter, when the newly elected officers and directors were introduced to the membership by Chapter Chairman Ed Horlebein.

Chesapeake Introduces New Officers, Directors

By Frederick L. Bruggman*, Baltimore, Md.

HOLDING its final meeting of the season May 22 at the Engineers Club, Baltimore, the Chesapeake Chapter honored its newly elected officers and directors. All selections of the Nominating Committee, headed by Wally W. Levi, Lynchburg Foundry Co., Radford, Va., were accepted by the members, after which the new incumbents were introduced by retiring Chairman Ed W. Horlebein, Gibson & Kirk Co.

J. E. Crown, U. S. Naval Gun Factory, Washington, D. C., was elected *President;* R. T. Covington, American Hammered Piston Ring Co., Div. of Koppers Company, Baltimore, *Vice-President;* L. H. Denton, Association of Commerce, Baltimore, *Secretary-Treasurer.* Directors newly elected are: Earl J. Bush, U. S. Navy Yard, Washington, D. C.; John W. Greenstreet, Maryland Car Wheel Co., Baltimore, and retiring Chairman Ed W. Horlebein.

The technical session which followed election of officers was conducted by John A. Heard, Crown Cork & Seal Co., Baltimore, who introduced two speakers in a discussion of the relationship of the pattern industry

*The Gibson & Kirk Co., and Reporter, Chesapeake Chapter.

to the foundry industry. Both speakers agreed that the ideal procedure in final production of a satisfactory casting at a fair price is the complete coordination of ideas between the design engineer, the patternmaker, and the foundryman.

The motion picture "Unfinished Rainbows," presented through courtesy of the Aluminum Co. of America, concluded the evening.

Synthetic Sands Topic at Pittsburgh Meeting

By R. L. Hartford,* Pittsburgh, Pa.

THE comparative merits of synthetic sands and natural bonded sands under various foundry conditions were discussed at the year's final technical meeting of the Pittsburgh Foundrymen's Association. Guest speaker was Frank Kleeman, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and in addition an interesting film on sand was presented by Whitehead Bros. Co., New York.

Mr. Kleeman discussed the pros and cons of both natural and synthetic sands as they apply to various types of foundry work. He pointed out some experiences with each type of sand in steel, gray iron and non-ferrous castings, particularly in connection with their control. He also summarized the behavior and effects of all types of sand, fire clay and binders when added to synthetic sand mixes.

*Pittsburgh Editor, *The Foundry*, and Reporter, Pittsburgh Foundrymen's Association.

Wisconsin Honors "Old Timers" and "Young Timers" of Indusry

A SPLENDID attendance turned out for the Wisconsin Chapter's last regular meeting of the season, held May 22 at the Hotel Schroeder, Milwaukee. The occasion was scheduled as "Old Timers' Night," and in addition the newly elected officers and directors were presented, and a large group of apprentices and students who were entered in local apprenticeship contests were honored.

Officers and directors, elected by letter ballot, who will serve the chapter during the coming year were presented, as follows: *President*, George K. Dreher, Ampco Metal, Inc., Milwaukee; *Vice-President*, Howard Waldron, Nordberg Mfg. Co., Milwaukee; *Treasurer*, R. F. Jordan, Sterling Wheelbarrow Co., Milwaukee; *Secretary*, Harry E. Ladwig, Allis-Chalmers Mfg. Co., West Allis; *Directors*—A. C. Ziebell, Universal Foundry Co., Oshkosh; Emil B. Hansen, Wisconsin Appleton Co., South Milwaukee; Robert C. Woodward, Bucyrus Erie Co., South Milwaukee.

The meeting was presided over by the new president, George Dreher. Past President B. D. Claffey, General Malleable Corp.,

(Photos Courtesy John Bing, A. P. Green Fire Brick Co.)
Some of the Wisconsin Chapter personalities who attended the last meeting of the season on May 22.

(Photos Courtesy John Bing, A. P. Green Fire Brick Co.)
Apprentices and students who participated in local apprentice contests were honored at the Wisconsin Chapter meeting, May 22. Among the apprentices were the local and national winners in the A.F.A. contests. (Top, Center)—President George K. Dreher, left, presents prizes to T. Sevenz, Ampco Metal Co., and C. Skrocki, Falk Corporation.

(Photos Courtesy John Bing, A. P. Green Fire Brick Co.)
"Old Timers' Night" at the Wisconsin Chapter. (Top Left—Past President B. D. Claffey, General Malleable Corp., Waukesha, presenting the traditional Past President's Ring to retiring President A. C. Ziebell, Universal Foundry Co., Oshkosh. (Top Right)—Director T. E. Ward, Badger Malleable & Mfg. Co., South Milwaukee. (Center, Left to Right)—Tee Porten, Wisconsin Industrial Commission; retiring President A. C. Ziebell; new Secretary H. E. Ladwig, Allis-Chalmers Mfg. Co., West Allis; new President George K. Dreher, Ampco Metal, Inc., Milwaukee. (Bottom)—Some of the "Old Timers" who attended the meeting.

Waukesha, presented the traditional past president's ring to the retiring chairman, A. C. Ziebell, and congratulated him on his splendid work.

Apprentices Honored

The many local apprentices and students were guests of the chapter, and included the national and local winners in the A.F.A. Apprentice Contests. Winners in the gray iron, steel, malleable iron, non-ferrous and patternmaking contests attended.

In addition, prizes were presented to the winners of the student essay contest by President George Dreher. Both of the essay contest prizes were awarded to students of Marquette University. First prize of $15.00 went to Roy F. Kern for his essay on "Rapid Carbon Determination of Remelt SAE 4300 Heats," while second prize of $10.00 was awarded Frank Bendler for a paper on "Moisture vs. Properties When Bonding Synthetic Steel Foundry Sands."

The essay contest is an activity of the Wisconsin chapter's Student Aid Committee, report of which was presented at the meeting by Chairman Dave Zuege, Sivyer Steel Co., Milwaukee. The report showed that 19 separate student loans are now outstanding, made to students at both Marquette University and the University of Wisconsin.

Membership Work Praised

The excellent work of W. A. Hambley, Allis-Chalmers Co., West Allis, as chairman of the membership committee, was highy praised, the committee report showing a gain of 135 new members during the past year. Other reports presented were those of the Foundry Conference Committee, headed by Howard Waldron; Program Committee, chairman of which is H. E. Ladwig, and the Apprenticeship Committee, of which R. S. Falk, The Falk Corp., is chairman.

Speaker of the evening was Tee Porten, Wisconsin Industrial Commission, Madison, who discussed matters pertaining to workers for wartime industry, particularly the foundry trade. Mr. Porten presented some very interesting information emphasizing the importance of training programs in all plants now engaged in war work.

Of the 12 prizes awarded in the national contests, apprentices in the Wisconsin area won six.

New Officers Elected by Ontario Chapter

By G. L. White,* Toronto, Canada

THE Ontario Chapter closed its season May 29th with a fine banquet and entertainment at the Royal York Hotel, Toronto, with 160 members and guests present. Chapter Chairman M. B. Clarke, Steel Co. of Canada, Ltd., Hamilton, presided, and praised the work of the Program Committee, under leadership of C. O. Williamson, Grinnell Co. of Canada, Ltd., Toronto, in arranging the affair.

Principal business of the evening was the installation of new officers and directors for the forthcoming year. Those elected are as follows:

Chairman—J. J. McFadyen, Galt Malleable Iron Co., Ltd., Galt; *Vice-Chairman*—C. C. MacDonald, Frederic B. Stevens of Canada, Ltd., Toronto; *Directors*—retiring Chairman M. B. Clarke; W. W. Nobbs, Clare Bros. & Co., Ltd., Preston; Charles A. Williamson, Grinnell Co. of Canada, Ltd., Toronto; J. A. Wotherspoon, Imperial Iron Corp., Ltd., St. Catherines; and James Dalby, Canada Metal Co., Ltd., Toronto, the latter to serve out the term left vacant by N C. MacPhee, Bureau of Mines, Ottawa, who resigned because of inability to attend executive meetings.

Other *Directors:* T. D. Barnes, Wm. R. Barnes Co., Ltd., Hamilton; T. Clough, Dominion

*Westman Publications, Ltd., Toronto, and Secretary-Treasurer, Ontario Chapter A.F.A.

(Photos courtesy G. L. White, Westman Publications, Inc.)
Some of the Ontario Chapter personalities who attended the May 29 meeting and banquet, marking the final meeting of the chapter for the season.

(Photos courtesy S. H. Hutchinson, A. H. Hutchinson & Sons, Ltd.)
The candid camera man had a field day when the Ontario Chapter gathered at the Royal York Hotel, Toronto, for its final session of the year.

Wheel & Foundries, Ltd., Toronto; J. Cunningham, International Malleable Iron Co., Ltd., Guelph; Robert Robertson, International Harvester Co. of Canada, Ltd., Hamilton; and J. C. Stavert, Babcock-Wilcox & Goldie-McCulloch, Ltd., Galt. G. L. White was re-elected *Secretary-Treasurer.*

May Meeting

Present-day cupola problems were considered at some length at the final technical meeting of the Ontario Chapter during the current season. The meeting was held at the Royal Connaught Hotel, Hamilton, May 1, with Chapter Chairman N. B. Clarke, Steel Co. of Canada, Ltd., Hamilton, presiding.

Speaker of the evening was D. J. Reese, International Nickel Co., New York, who was introduced by Hugh G. Watson, Alloy Metal Sales, Ltd., Toronto. In introducing his subject, "The Cupola and Contemporary Problems of Materials," Mr. Reese stated that courage as well as skill is required in dealing effectively with the problems involved in cupola operations today. These problems have resulted from changes available in raw material supplies and by the demand for greatly increased production.

The speaker's remarks were confined largely to the cupola in cast iron work. However, it was pointed out that the cupola has many applications in duplex and triplex processes and also is used in some instances in the melting of bronze for large castings.

Much of the chemistry of the process in the cupola, the speaker declared, depends upon the skill of the charging gang and the suitability of their equipment. By proper proportioning of charges, much can be done to increase thermal efficiency.

Mr. Reese also discussed methods of tapping the cupola and made reference to the alteration of metal in the ladle, the need for transferring metal from furnace to mold as quickly as practical, and filling the mold as rapidly as possible.

Detroit Men Learn of Cupola Converter Use

By O. E. Goudy,* Detroit, Mich.

MEETING on April 16 for the first time at the new Rackham Educational Memorial Building, 75 members and guests of the Detroit Chapter gathered to discuss the cupola converter process. Chapter Chairman V. A. Crosby, Climax Molybdenum Co., Detroit, introduced the speaker of the evening, A. W. Gregg, Whiting Corp., Harvey, Illinois.

Mr. Gregg presented an interesting paper on the "Cupola Converter Electric Furnace Process" for making steel, a subject of considerable importance in this day of armaments. After covering something of the design and operation of the converter, Mr. Gregg showed some of the newer phases of operation, including use of the electric eye for measuring flame color at the end of the blow. He also described tests now being made on converter steel for broader applications than now current.

*Kelsey-Hayes Wheel Co., and Reporter, Detroit Chapter.

Honor Edro Richardson For Long Time Service

OUTSTANDING among the events of the March meeting of the Chesapeake chapter was a personal testimonial given by the members to one of Baltimore's oldest foundrymen, Edro Richardson, a "young-timer" of 67. A visitor to the chapter, the story of Mr. Richardson's 56 years in the foundry business in Baltimore proved a fascinating recital.

Mr. Richardson started in the foundry business as an apprentice at the age of 11 in the spring of 1886, with the old Maryland Brass and Metal Works. At the ripe old age of 17 he was appointed foreman of the shop, and continued with that firm until 1897. On January 11 of that year he went into business for himself, originating the Edro Richardson Brass Co. at 316 N. Holliday Street, where he continued until the Baltimore fire of 1904.

Moving his business next door he operated there until 1923, when he purchased a large build-

*The Gibson and Kirk Co., and Reporter, Chesapeake Chapter.

Edro Richardson

ing at Monument and Kresson Streets, and there operated a modern foundry and brass fitting shop until 1938. As a result of the depression Mr. Richardson closed the business he had established, but in just a few months started in business again at 442 N. Front Street, where he has been actively engaged in brass specialty work ever since.

As a reminiscence of old times Mr. Richardson presented to Chapter Chairman E. W. Horlebein a badge given him in 1906, at a banquet held at the old Lexington Hotel at Holliday and Lexington Streets, as a member of the former Baltimore Brass Foundrymen's Association. He explained that after President Cleveland's administration, tariffs were very much in evidence and copper, lead and zinc prices soared sky high. The Baltimore Foundrymen's Association was organized to try to establish selling prices among local foundrymen, and it continued for about four years, holding meetings once a month with a banquet once a year.

Mr. Richardson's long years of service mark him as an outstanding personality of the Baltimore foundry industry, still supplying requirements for valves, fittings and special machine work in the vicinity.

California Foundrymen Mourn Ben Page Death

BENJAMIN C. Page, associated with the F. K. Simonds Co., Berkeley, Calif., since 1923, and a member of the Northern California Chapter of A.F.A., died May 3 from a heart attack suffered in March. Mr. Page was a native of Stockton, Calif., and for most of his business career was connected with the Pacific Coast foundry business.

After attending the public schools and business college, he apprenticed himself to the foundry of the Holt Mfg. Co., of which his uncle was owner, and in 1913 was made superintendent of the Stockton plant. Two years later he was sent East to study electric furnaces, and while there attended his first A.F.A. convention, in Atlantic City. Returning to the Coast, he was made superintendent of the Holt plant at Spokane, Wash., where he remained until 1918, when he accepted the position of superintendent of the Three Rivers, Mich., plant of the Fairbanks Morse Co.

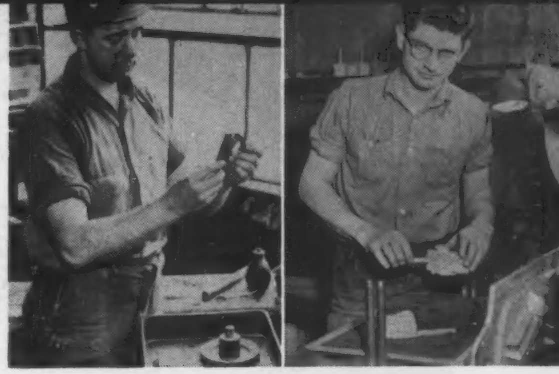
However, he returned to California in 1921 and became superintendent of the Best Steel Casting Co. plant at San Leandro. Since 1923 he had operated the Simonds foundry in Berkeley.

Benjamin C. Page

Mr. Page was president of the Northern California Foundrymen's Institute and a director of the Northern California Chapter of A.F.A. One of his two sons, Captain Gordon B. Page, is now stationed with the U. S. Army Engineers at Schofield Barracks, Hawaii.

Book Review

Mechanism, by Stanton E. Winston, cloth binding, 372 pp., 199 illustrations, published by American Technical Society, Chicago, Ill. Price $3.50. Here is a fundamental book relating to the theory of the modifications and transmission of motion. It is a new book written in a "how-to-do-it" manner. This book goes to the root of all important points and explains them in a way that is clear and practical. Difficult points are based on something the reader already knows, which allows him to gradually build up his knowledge of mechanism, with each new step made easier by careful association with some factor that is already thoroughly understood. After each principle has been explained, illustrative examples are presented and solved as a means of showing the application of the principle. Thus each principle is explained by written explanation; pictures or line drawings; and by illustrative problems. There are over 250 practice problems and all exactly fit the explanations of the principles. This book covers mechanisms, machines, links, turning and sliding pairs, graphic solutions, layouts, motion, relative velocities in link work, velocity diagrams, toothed wheels or gears, trains of mechanism, cams and many other items. This book is a good book for home study, reference, classroom and defense training use.



Two of the winners in Gray Iron molding in the 1942 A.F.A. National Apprentice Contests. (Left) Edward Drebus, Universal Foundry Co., Oshkosh, Wis., second prize. Neil B. Hamilton, Caterpillar Tractor Co., Peoria, Ill., first prize.

Apprentices who won honors in the recent A.F.A. Apprentice Contests, judged at the Cleveland Convention. (Left) Joseph Nawikas, Sheboygan Foundry Co., Sheboygan, Wis., third prize in Gray Iron Moulding. Richard Kilch, Miehle Printing Press & Mfg. Co., Chicago, third prize in Patternmaking.

Abstracts

NOTE: The following references to articles dealing with the many phases of the foundry industry, have been prepared by the staff of *American Foundryman*, from current technical and trade publications.
When copies of the complete articles are desired, photostat copies may be obtained from the Engineering Societies Library, 29 W. 39th Street, New York, N. Y.

Converter

(*See Steel*)

Gray Iron

CUPOLA OPERATION. *"Cupola Operations,"* by D. J. Reese, *Canadian Metals and Metallurgical Industries,* vol. 5, No. 3, March, 1942, pp. 68-71. The cupola melting process is unique in several important aspects. In this process, metal and fuel are in intimate contact from the time of charging until metal is tapped from the furnace. The cupola is a high-speed melting process and the element of time is important. The cupola melting process is a continuous melting process, in that usable metal may be tapped from the furnace at any time during the period in which the furnace is in operation. In discussing carbon the author says that the actual amount of carbon absorbed in the cupola melting process is dependent on the carbon content of the charge, the chemistry of the iron, the amount and characteristics of the fuel used, the temperatures existing in the furnace and the method of tapping the furnace, etc. In fuel control good judgment must be employed in the use of coke. The author stresses the importance of ratios, the size of the fuel particles and how much fuel to use on the coke bed. The author recommends these operations for outstanding cupola operation—acknowledge the importance of fuel-metal relationship, use a fuel reasonably sized to the cupola, use small weight units for the fuel charge and weigh these fuel units accurately. A brief discussion of the combustion reactions in the cupola also is made. Some interesting facts concerning melting rates are made. The author presents data on the three methods for tapping metal from a cupola: intermittent tapping and botting, continuous flow of metal through an accurately sized tap hole with a constant head of metal in the well zone and continuous flow of slag through a rear slag hole, and the front slagging spout. Each is discussed in detail. In conclusion the author presents some ideas of steel in the cupola charge. (F.)

Historical

FOUNDING. *"Founding Through the Ages,"* by A. Logan, *The Metal Industry* (London), vol. 50, No. 5, January 30, 1942, pp. 66-69. An interesting review of the history of metal founding from the earliest days when this art was started up to the modern foundry of today. A general over-all knowledge is given concerning the application of scientific knowledge, improvements in foundry appliances, sand control and synthetic sand, the Randrupson process and modern melting equipment. (Hi.)

Non-Ferrous

ELECTRIC FURNACE. *"Electric Furnaces for Non-Ferrous Heat Treatment,"* by J. E. Oram, *The Metal Industry* (London), vol. 50, No. 5, January 30, 1942, pp. 94-96. Though this article covers quite a range of alloys it is proposed to consider the following division: Light alloys, aluminum and magnesium. The main treatments to be considered for these materials are: billet heating for extrusion, stamping and forging; annealing; solution treatment; and precipitation treatment, or age-hardening. The four types of treatments are discussed in detail for use on light alloys. (H.T.)

FOUNDRY PLANNING. *"Planning the Non-Ferrous Foundry,"* by N. K. B. Patch, *The Foundry,* vol. 70, No. 3, March, 1942, pp. 74, 146-148. In continuing his article concerning the construction of a non-ferrous foundry the author this month takes into consideration the cleaning room. The cleaning room must be located where the castings after shaking out from the molds can be delivered with a minimum amount of time and labor expenditure if the most economical practice is to be insured. Study the flow of production when planning a cleaning room. The author considers both the production of large and small castings and how they should be processed in the cleaning room. In concluding this paper the author discusses the removal of gates and risers, tumbling and cleaning by blasting. (N.F.)

HEAT TREATMENT. *"Heat Treatment of Copper and Its Alloys,"* by E. D. de Coriolis and Wm. Leher, *The Metal Industry,"* (London), vol. 50, No. 9, February 27, 1942, pp. 156-158. This article explains the fundamental reactions of gas constituents in protective atmospheres, the effect of sulphur, lubricants and delayed discoloration and precautions in application of protecting atmosphere. (H.T.)

MAGNESIUM. *"The Ford Magnesium Alloy Foundry,"* by Edwin F. Cone, *Metals and Alloys,* vol. 15, No. 3, March, 1942, pp. 396-402. Mounting aircraft production requirements have made a drastic change in magnesium alloy foundry practice and the Ford foundry is no exception. This article describes the Ford Motor Co.'s new foundry for making magnesium alloy aircraft castings, and the up-to-date melting, casting and heat treating practices employed. Also discussed is molding practice and the handling of cores. An interesting discussion on some of the solved and unsolved problems experienced by Ford's foundry are outlined. (Al.)

TESTING. *"Fatigue Testing of Zinc-Base Alloy Die Castings,"* by E. H. Kelton, American Society for Testing Materials, preprint No. 38 of 1942 convention paper. The paper describes fatigue tests conducted on die-cast specimens of several zinc-base die-casting alloys, made to satisfy occasional demands for these values. Specimens were subjected to three aging conditions before testing: 6 months at room temperature; 6 hours in 95°C. (203°F.); and 5 days in 95°C. steam. Testing was done at 25±1°C. (77±1.8°F.) at a speed of 1600 cycles per minute in a flexure type machine. The majority of specimens were ¼ in. thick but a few were ⅛ in. thick. Results were checked superficially by rotating cantilever-beam tests. The endurance limit was arbitrarily chosen as the greatest stress not causing failure at 100,000,000 cycles. Each point on the S-N curve was the first failure in a 20-specimen test at the same stress. The flexure fatigue limits determined are compared with tensile values. The few tests on ⅛ in. specimens failed to indicate a significant difference due to specimen size. The rotating beam tests indicated only that the flexure tests were on the conservative side. Since the endurance limits were established on the basis of the first failure in 20 specimen tests, it is believed that a factor of safety of 1.20 to 1.30 should be adequate for engineering calculations.

Steel

ALLOY. *"Use of 'Chrom-X' in Steel Making,"* by J. H. McDonald, *Metals and Alloys,* vol. 15, No. 2, February, 1942, pp. 249-253. This "Chrom-X" material was described in an earlier issue of this magazine and described the manufacture and use of this new material for adding chromium to alloy steels. "Chrom-X" is made from low-grade chromium ores. This paper relates the experience of a large steel maker in the application of Chrom-X in producing certain alloy steels of which chromium is an essential constituent. Various phases of the metallurgical operations involved are discussed. (S.)

CONVERTER. *"Some Practical Considerations of the Use of Side-Blow Converters in the Present Emergency," Canada's Foundry Journal,* vol. 15, No. 2, February, 1942, pp. 16-17, 20-21. The advantages of the converter process for the production of light and medium castings are: the cheapness of the installation, flexibility in operation, for metal may be produced at intervals throughout the day and the high temperature and excellent fluidity of the steel produced. Wartime conditions demand changes in thought as well as in manufacturing processes. Steel manufacturers should seriously review their procedure in the light of changed conditions; this review should include the possibilities of the side-blow converter. (F.)

CONVERTER. *"The Converter's Place in War Production,"* by A. W. Gregg, *The Foundry*, vol. 70, No. 3, March, 1942, pp. 66-67, 159-160. The two most important factors contributing to the converter's comeback are (1) the development of a practical means of reducing the sulphur content in the cupola metal and (2) the development of electric eye apparatus to aid the converter operator in controlling the operation more accurately. The author states that it is now possible to hold the sulphur content in the finished steel to 0.03 per cent or less. Operation of the converter is no longer entirely dependent upon the eye of the operator. With the use of electric eye control, operators can be trained in a short time to produce quality castings with a converter. Like other steel-making processes, the converter depends upon oxidation for the refining operation. The five steps in this operation are melting cycle, superheating cycle, oxidation of metalloids to a very low percentage, removal of excess oxides and adjustment with recarburizers to the required composition. In the converter this cycle is accomplished in 15 to 17 minutes. (F.)

Steel

ALLOY. *"Conservation of Alloys in the Open Hearth,"* by W. J. Reagan, *Metals and Alloys*, vol. 15, No. 5, May, 1942, pp. 741-744. Alloy stringency has caused development of so-called "emergency steels" so high in "residual" alloy content as to suggest a broad program for maximum alloy conservation. Such a program is strongly urged by the author, who discussed reasons for increases in residual contents of tin, manganese, chromium and nickel in open-hearth steels. A program of alloy conservation should embody five main points: (1) Segregation of all alloy-bearing scrap, where percentage of alloy content justifies such segregation, and use this material as alloy containing scrap; (2) institute program of slag and furnace control to obtain maximum benefits from furnace practice, both in open-hearth and electric furnace; (3) change specifications to use minimum of essential alloys; (4) use materials at present on hand but not usable due to being tied in with other alloys; (5) study present steelmaking activities to determine in what plants large quantities of essential alloys are found in plain carbon steels.

FURNACE TEMPERATURES. *"Temperature Distribution in the Liquid Steel in Various Steelmaking Furnaces,"* by D. A. Oliver, Institute of British Foundrymen, Advance Paper, Mid-April, 1942. Temperature distributions in three dimensions in the liquid steel in different types and sizes of steel furnaces are recorded in this paper. Temperature measurements were made by Schofield-Grace method. Detailed observations are given pictorially for 40 and 25 ton* acid open-hearth furnaces, for 12 and 3 ton* and 30 cwt.** basic electric arc furnaces, also a small 100 lb. high-frequency furnace with a basic lining. Results are tabulated showing maximum observed variations in both the vertical and horizontal directions corresponding to different stages in the melting processes. Variations lie between zero and 45°C. (113°F.) Very small differences from point to point were found in all types of furnace when the metal bath boiled, but larger temperature variations were built up during the finishing stages when the stirring action of escaping gases was negligibly small. Mechanical stirring resulted in greater equalization, and is recommended prior to an immersion reading when precise control is being exercised. The author concludes that, subject to where temperature is measured, the observed single value is likely to be representative of the mean temperature under normal conditions to within ±10°C. (50°F.) or to within ±20°C. (68°F.) under extreme conditions.

*British ton, equaling 2,240 lbs. **1 cwt. equals 112 lbs.

HOT TEARING. *"Investigation of the Influence of Mold Friction on Tearing in Castings,"* by Prof. J. H. Andrew and H. T. Protheroe, *Foundry Trade Journal*, vol. 66, No. 1329, February 5, 1942, pp. 83-86. From the large number of tests carried out in this investigation it would appear that hot tearing is due rather to the resistance offered to contraction by the bulk of sand than to the nature of the sand itself. When steel castings are stripped from the box, it was observed that there was a thin layer of burnt sand between the face of the casting and the main body of the sand. This layer is very friable and, provided the refractoriness was originally sufficient, it is easily removable from the casting. No attempt was made to explain the sulphur segregation near the runner and riser, but it was felt that the temperature at the crucial moment during contraction would decide where the casting tears. In every test carried out this was near the runner, that is, in the hottest region. With regard to casting temperature, the only deduction possible from the varied number of casting temperatures employed is that tearing occurs some time after solidification, probably very soon afterwards. (S.)

Testing

CHEMICAL. *"Qualitative Chemical Tests,"* by E. C. Pigott, *Iron and Steel*, vol. 15, No. 7, March, 1942, pp. 196-199, 202. The methods of quantitative analysis although usable and certain often take too much time to be really serviceable as routine qualitative tests. The author has for many years been engaged in the development of more rapid qualitative methods for alloy irons and steels; some of these methods are given in this article. Many of them involve the use of organic reagents, which can give misleading results unless the tests are carried out under the correct conditions. The author has devoted much time to the establishment of such conditions which should be adhered to. The necessary conditions attaching to purely inorganic methods also are given where required. (Te.)

COHESION. *"The Technical Cohesive Strength and Yield Strength of Metals,"* by D. J. McAdam, Jr., *Metals Technology*, vol. 9, No. 1, January, 1942, pp. 1-47. The technical cohesive strength of a metal cannot be represented by a single stress value, but comprises an infinite number of stress values (cohesion limits) corresponding to the infinite number of possible combinations of the principal stresses. Plastic deformation increases the technical cohesive strength continuously up to the point of fracture. The three-dimensional diagrams representing the technical cohesive strength of a metal has a three-cornered contour, in a plane perpendicular to the locus of polar-symmetric stresses, and tapers nonlinearly to a point. With plastic deformation, the diagram representing yield enlarges more rapidly than the other diagram. Some speculations are made about the form of the three-dimensional diagram representing resistance to shearing fracture, and its relation to the diagrams representing yield and rupture. There is need for determination of the values of T_c, $T_{c'}$, T_o, and T_r for various brittle materials. (Me.)

HARDNESS. *"Hardness Conversion Relationships,"* by Robert H. Heyer, American Society for Testing Materials, preprint No. 88 of 1942 convention paper. Conversion relationships now in general use for materials in the Rockwell "B" range of hardness are not satisfactory for certain classes of materials, such as aluminum and its alloys and the austenitic stainless steels, but apply very satisfactorily to yellow brass. To study the relationships between hardness scales based on pyramid and ball types of penetrators, the following tests were made on a variety of materials: Vickers 10 kg., 30 kg., and 50 kg.; Rockwell "B" and "F"; Rockwell Superficial 45-7, 30-7 and 15-T. In addition to the standard procedures, the diameters of all Rockwell impressions were measured with the Vickers microscope in order to establish work-hardening capacities by Meyer's analysis. Three factors which contribute to the uncertainty of present hardness conversion relationships when applied to a variety of materials having hardnesses in the Rockwell "B" range were found, and are reported in the paper, as follows: (1) Differences in work-hardening capacities; (2) differences in the contours of the hardness impressions; (3) high rates of flow under load in the hardness test. Of these factors, the first is considered most important in most cases.

MICROSCOPIC EXAMINATION. *"Microscopic Examination of Metals,"* by J. B. Bassett, *Canadian Metals and Metallurgical Industries*, vol. 5, No. 3, March, 1942, pp. 72-77. Equipment necessary for microscopic examination consists of a polishing wheel, abrasive papers, a few chemical reagents and microscope. The author gives pertinent information concerning the cutting of samples and advises against using metal-cutting methods. The specimen should be polished and this falls into the rough and final polishing stages. A detailed account of polishing is given. The etching technique also is related in detailed form. After commenting upon the use of the microscope and how it should be cared for, the author explains the structure of copper and its alloys, aluminum and its alloys, and iron and steel. Some very interesting photomicrographs help illustrate the author's paper. (Me.)

Training

APPRENTICES. *"Training Apprentices in the Laboratory,"* by H. R. McCoy, *The Foundry*, vol. 70, No. 2, February, 1942, pp. 58-60, 157-159. A general review of what system the Ohio Steel Foundry Company employs in securing apprentices to work in their laboratory. An outline is presented of what type work the apprentice is given to do first and how he is gradually taught the routine jobs connected with laboratory work. Later he is made acquainted with the various departments of the plant and what type work each of these sections is required to do. Advancing from the metallurgical to metallography and gamma ray divisions is then done and various jobs are assigned him. The apprentice is expected to devote at least 4 hours a week to study and reading. Exams are given every 3 months to find out how many fundamental facts the apprentice has been able to assimilate during the period. (Tr.)